FOREWORD

This Manual is intended to help workshop personnel perform repair and maintenance work quickly and successfully on the mechanical governor RLD (K) for diesel engines.
The Manual explains the design and mode of operation of the governor and describes how it is to be disassembled, assembled and adjusted.
The illustrations, schematic drawings and technical data in this Manual represent the state of the art at the time of publication. The technical data and procedures to be employed for repair and maintenance may be subject to change.

TECHNICAL FEATURES

The type RLD(K) mechanical governor developed by Diesel Kiki for motor-vehicle diesel engines is characterized by the following technical features:

1. The governor is a variable-speed governor with reduced control-lever operating force. A new linkage design relieves the high governor-spring force on the control lever. This results in a considerable reduction in the operating force required for the control lever, which is now equivalent to that of a minimum-maximum-speed governor.

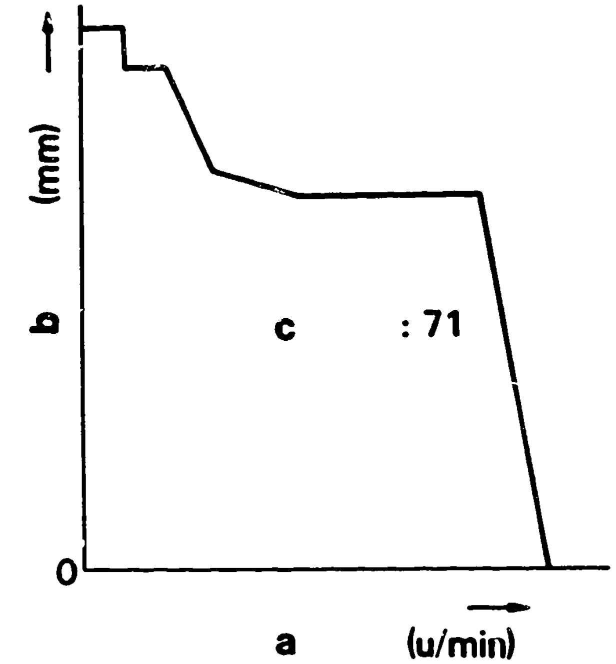


Fig. 1

a = Pump speed
b = Control-rod travel
c = Torque-control edge cam

Fig. 2

a = Pump speed
b = Control-rod travel
c = Torque-control edge cam

2. It is not only possible to regulate the delivery map required for full-load operation of the engine, but also to adjust the excess fuel for starting in accordance with the engine starting requirements. This is done by simply replacing the torque-control edge cam with a more suitable edge cam. Figs. 1 and 2 illustrate for example how the speed behaviour of the governor changes when using a different edge cam.

DESIGN

Each flyweight is supported by a pin pressed into the flyweight mount. This in turn is attached to the camshaft of the fuel-injection pump.
The flyweights pivot outwards about their bearing pins. This outward movement is transmitted by way of a link attached to either end of the bell crank of the flyweights in an axial direction to the sliding sleeve and from the sliding sleeve to the sliding bolt. The sliding sleeve is connected to the sliding bolt by means of a bearing. The sliding bolt is hinge-mounted on a pin at the bottom end of the tensioning lever and only moves axially. The tensioning-lever shaft, which supports the tensioning lever, is installed roughly in the center of the governor cover. Mounted at the top end of the tensioning lever on a pin is a spring seat, the center bore of which surrounds the governor shaft. The governor shaft is held in position by a guide screw (locked against the governor cover) and the governor housing. The governor shaft only moves in an axial direction.
A further spring seat is located on the drive end of the governor shaft. The governor springs are not subject to any tension between these two spring seats.

Design (continued)

The cover end of the governor shaft features a thread onto which a nut is screwed. This nut is used to adjust the position of the spring seat on the drive end. An idle spring retainer is installed in the bottom of the governor cover; the idle spring makes contact with the cover end of the sliding bolt. Over the entire engine speed range, the governor and idle springs maintain equilibrium with respect to the force generated by the flyweights. In this process, the tensioning lever is moved to the position corresponding to the flyweight stroke.
The guide lever and the tensioning lever are concentrically mounted on the tensioning-lever shaft and are held together by the force of the return spring (1). A spherical bolt is welded to the upper side of the guide lever. The variable-fulcrum lever is centered by a support lever. Both ends of the variable-fulcrum lever are fork-shaped, with one end engaging the spherical bolt of the guide lever and the other end engaging the spherical bolt of a connecting link. The connecting link is attached to the control rod. One end of the starting spring is positioned in the spring boss of the governor housing; the other end is positioned in the connecting link. The starting spring always acts such that the control rod is pulled in the direction of increased delivery. The control-lever shaft is supported by a lever and held by a return spring (2). The control lever, support lever and control-lever shaft form a complete assembly. Operation of the control lever causes the center pivot point of the variable-fulcrum lever to be shifted by the support lever.

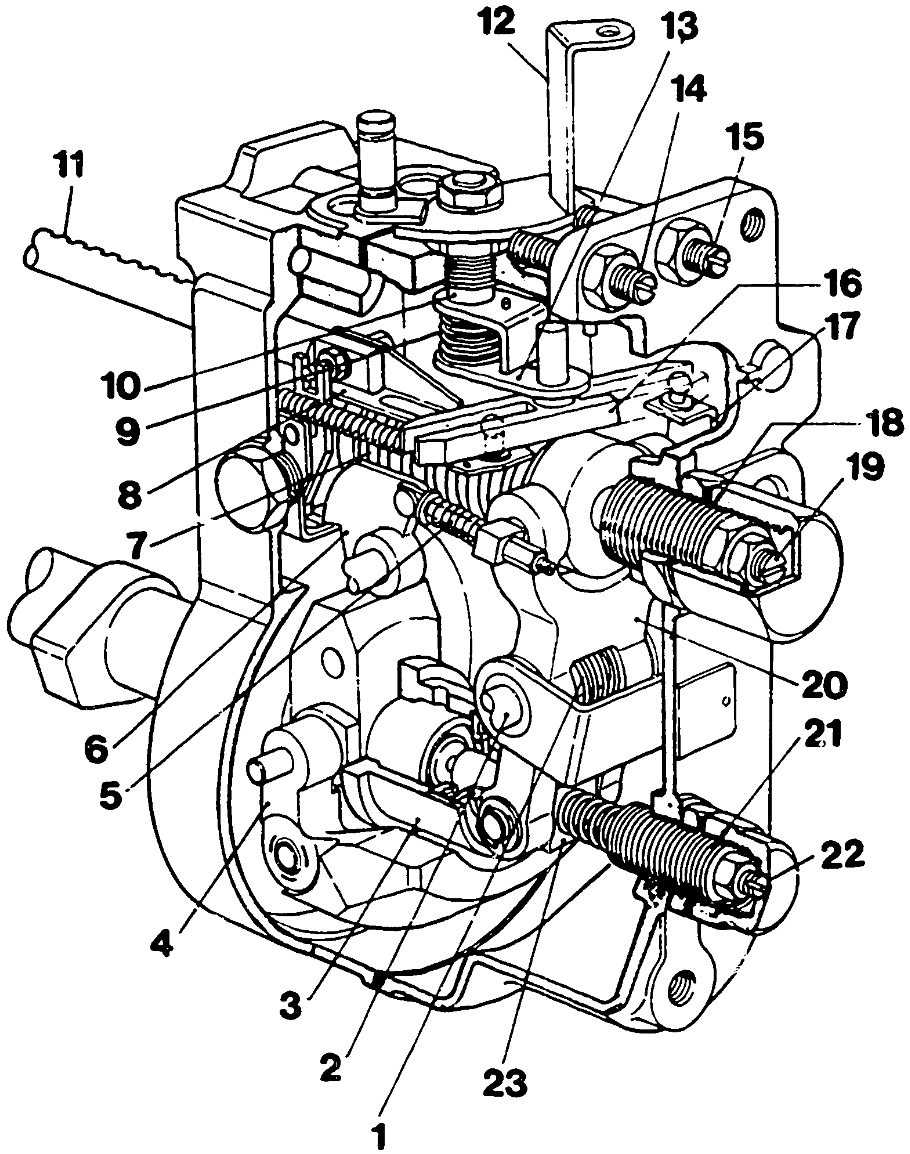


Fig. 3 Design

1 = Return spring (1)
2 = Tensioning-lever shaft
3 = Sleeve
4 = Flyweight
5 = Connecting rod and spring
6 = Torque-control edge cam
7 = Governor spring
8 = Connecting link
9 = Return spring (2)
10 = Control-lever shaft
11 = Control rod
12 = Control lever
13 = Support lever
14 = Full-load adjustment screw
15 = Idle-speed adjustment screw
16 = Variable-fulcrum lever
17 = Guide lever
18 = Guide screw
19 = Governor shaft
20 = Tensioning lever
21 = Idle-spring assembly
22 = Adjustment screw
23 = Sliding bolt

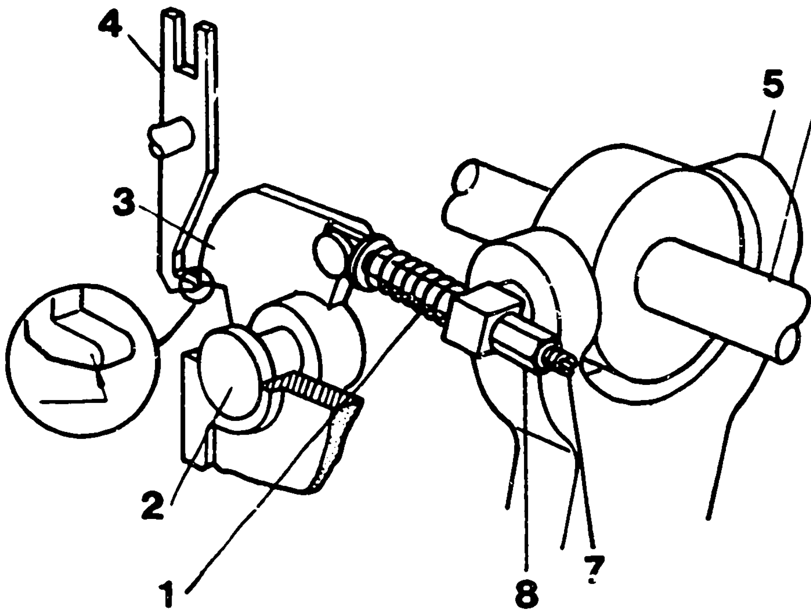


Fig.4: View of torque-control edge-cam mechanism

1 = Connecting rod and spring
2 = Pressed-in bearing pin
3 = Torque-control edge cam
4 = Sensing lever
5 = Tensioning lever
6 = Governor shaft
7 = Securing screw
8 = Adjusting nut

As shown in Fig. 4, the torque-control edge cam is supported by a pin pressed in on the inside of the governor cover (control rod end). The edge cam is connected by means of a connecting rod and an adjusting nut to the end of the pin forming a spring bearing at the upper end of the tensioning lever.

The distance between the edge cam and the tensioning-lever pin is set with the aid of the adjusting nut on the thread end of the connecting rod and securing screw. The force of the two springs on the connecting rod can be altered using the adjusting nut.
The torque-control edge cam pivots about its bearing pin either on adjusting the connecting rod or as a result of the movement of the tensioning lever when there is a change in the deflection of the fly-weights.

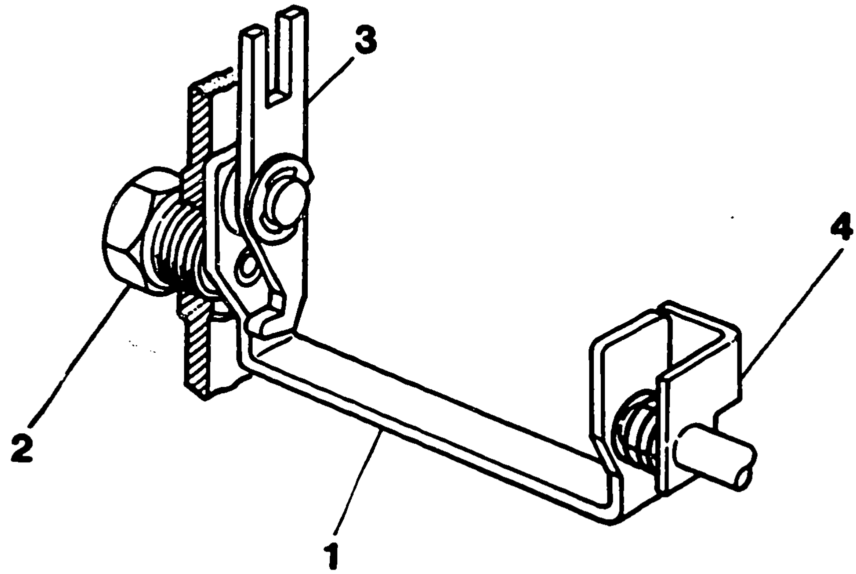


Fig. 5 Sensing-lever mechanism

1 = U-lever
2 = Guide screw
3 = Sensing lever
4 = Full-load adjustment lever

A nut and a shaft are installed in the governor housing on the side opposite the control rod. A bushing is attached to the shaft. A U-lever fitted to the bearing pin of the sensing lever is installed between the shaft supported by the bushing and a guide screw as indicated in Fig. 5. The U-lever, the shaft in the bushing and the return spring (3) move as one assembly.

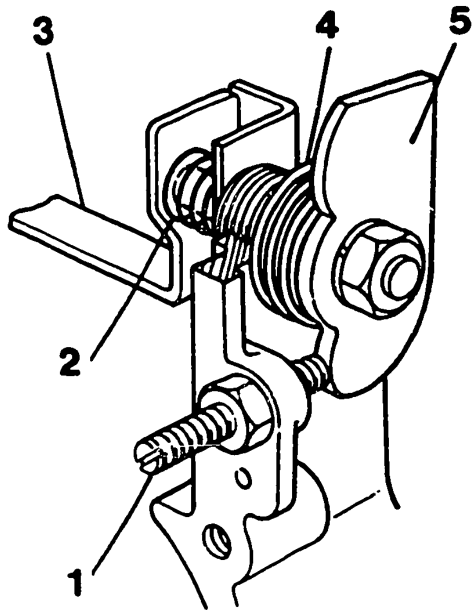


Fig. 6 Full-load adjustment mechanism

1 = Full-load adjusting screw
2 = Return spring (3)
3 = U-lever
4 = Return spring (3)
5 = Full-load adjustment lever

The sensing lever is supported by the U-lever. The upper end of the sensing lever takes the form of a fork and surrounds a screw which holds control rod and connecting link together. The lower end of the sensing lever makes contact with the torque-control edge cam. The adjustment lever for full load and the return spring are mounted on the full-load adjustment-lever shaft as shown in Fig. 6.

The full-load adjustment lever is constantly pressed against the full-load adjusting screw. If the full-load adjustment lever moves, this results in corresponding movement of the sensing lever. Two adjusting screws for the maximum speed and idling speed of the engine are provided on the top of the circular governor cover.

BASIC INFORMATION ON MODE OF OPERATION

Variable-speed control

Unlike a standard variable-speed governor, which regulates the engine speed in line with the governor-spring force set by way of the control lever, the mechanical governor of type RLD (K) controls the engine speed by adjusting the fulcrum of the variable-fulcrum lever with the control lever. Only a very small force is required with the RLD (K) governor for operating the control lever.
Fig. 7 illustrates the relationships between the injection-pump speed, the flyweight stroke and the control-rod travel.
Fig. 8 shows how the mechanical RLD (K) governor works.

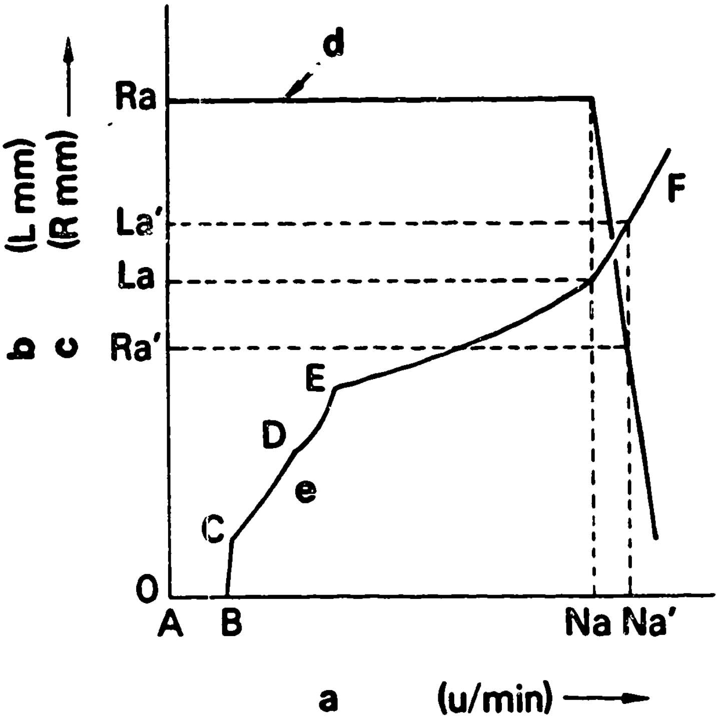


Fig. 7

a = Pump speed
b = Flyweight stroke
c = Control-rod travel
d = Control-rod-travel profile
e = Flyweight-stroke profile

The idle spring and the governor spring of the RLD (K) governor do not produce any initial adjustment force; if the flyweight stroke is 0 as illustrated in Fig. 7, the initial adjustment force is provided merely by the starting spring. The deflection of the flyweights thus starts at a speed greater than the pump speed (B) which produces the centrifugal force necessary to overcome the initial adjustment force of the starting spring.

Variable-speed control (continued)

If the engine speed increases, the centrifugal force exceeds the adjustment forces of the idle and governor springs (Fig. 7B - F); the maximum flyweight stroke is 13 mm.

The movement of the flyweights as they swivel out or in is transmitted by the sliding bolt to the tensioning lever, thus causing the guide lever to move as well. The movement of the guide lever is transmitted to the variable-fulcrum lever which then shifts the control rod in the opposite direction.

If the control lever is moved slightly out of the idle position in the direction of the maximum-speed adjusting screw and the spherical pin of the guide lever is held at "Po", the support lever causes the variable-fulcrum lever to turn about the point "Po" if the fuel-injection pump is not in operation (solid lines in Fig. 8).

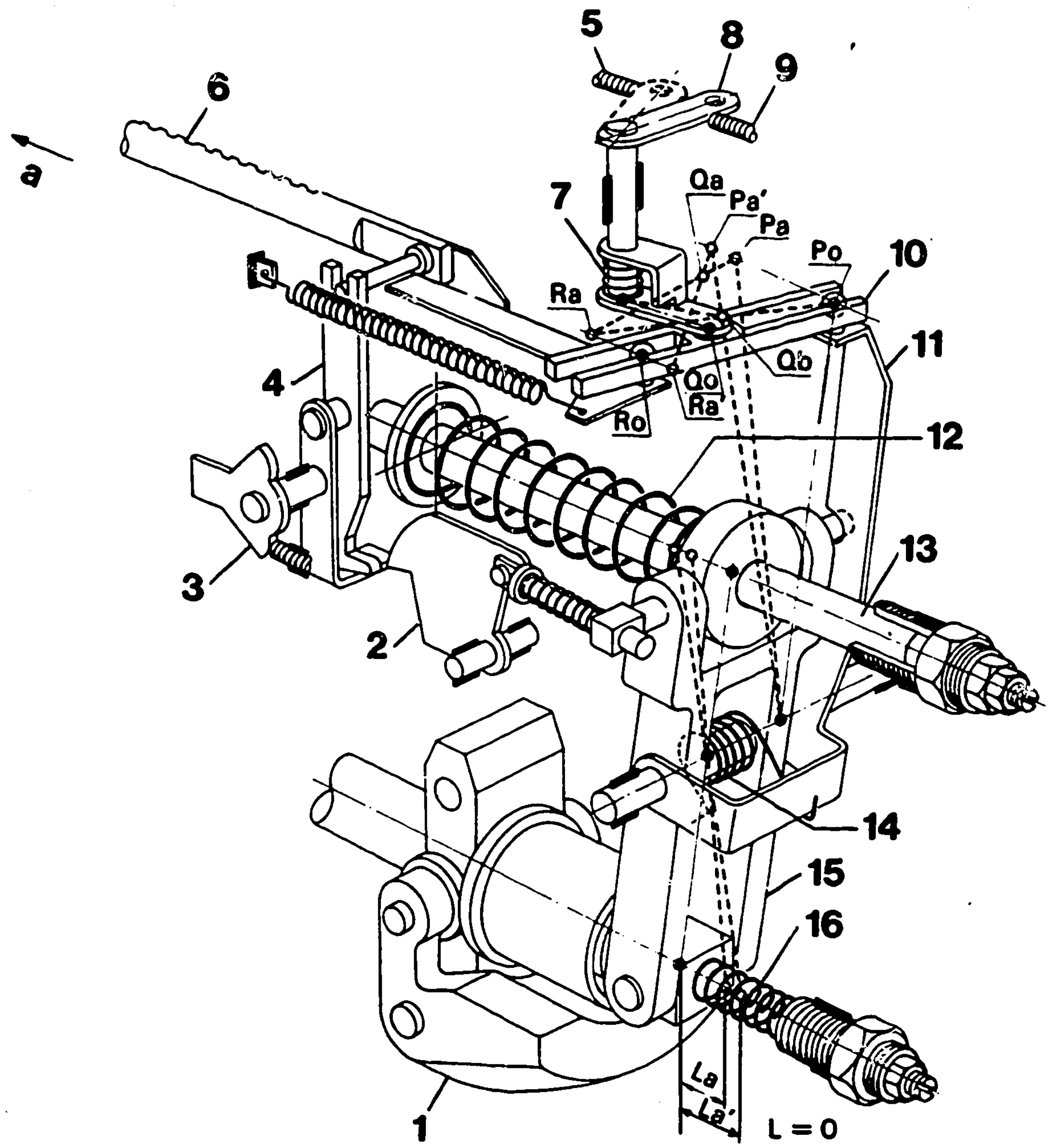


Fig. 8

1 = Flyweight
2 = Torque-control edge cam
3 = Full-load adjustment lever
4 = Sensing lever
5 = Maximum-speed adjusting screw
6 = Control rod
7 = Return spring (2)
8 = Control lever

9 = Idle-speed adjusting screw
10 = Variable-fulcrum lever
11 = Guide lever
12 = Governor spring
13 = Governor shaft
14 = Return spring (1)
15 = Tensioning lever
16 = Idle spring

a = Direction of incr. delivery

Point P: Fulcrum of spherical pin on guide lever
Point Q: Fulcrum of variable-fulcrum lever
Point R: Fulcrum of connecting link

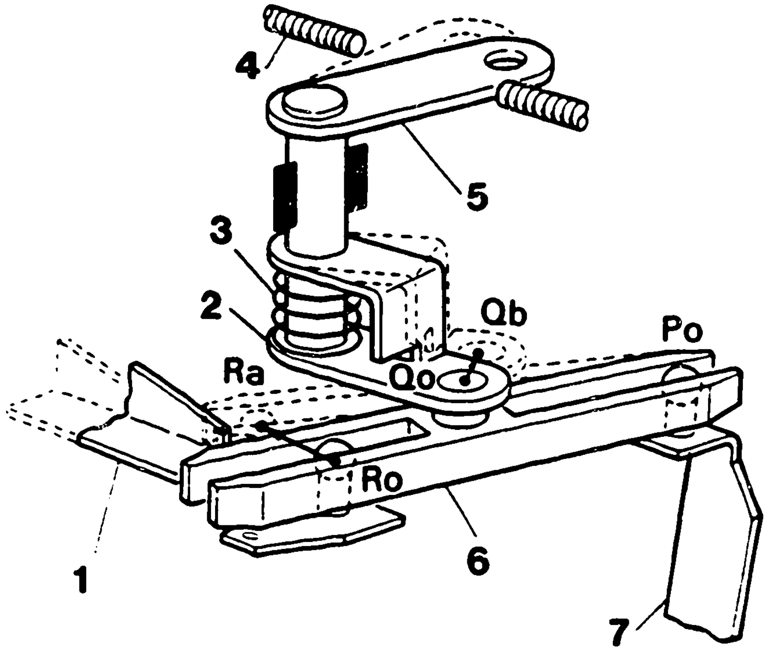


Fig. 9

1 = Connecting link
2 = Support lever
3 = Return spring (2)
4 = Maximum-speed adjusting screw
5 = Control lever
6 = Variable-fulcrum lever
7 = Guide lever

As soon as the variable-fulcrum lever starts to turn, the control rod moves from Ro in the direction of increased delivery. Once the control rod has reached the position Ra, two pivots (Po and Ra) are fixed. The pivot of the variable-fulcrum lever is then at point Qb on the line between the variable-fulcrum-lever pivots Po and Ra (Fig. 9).

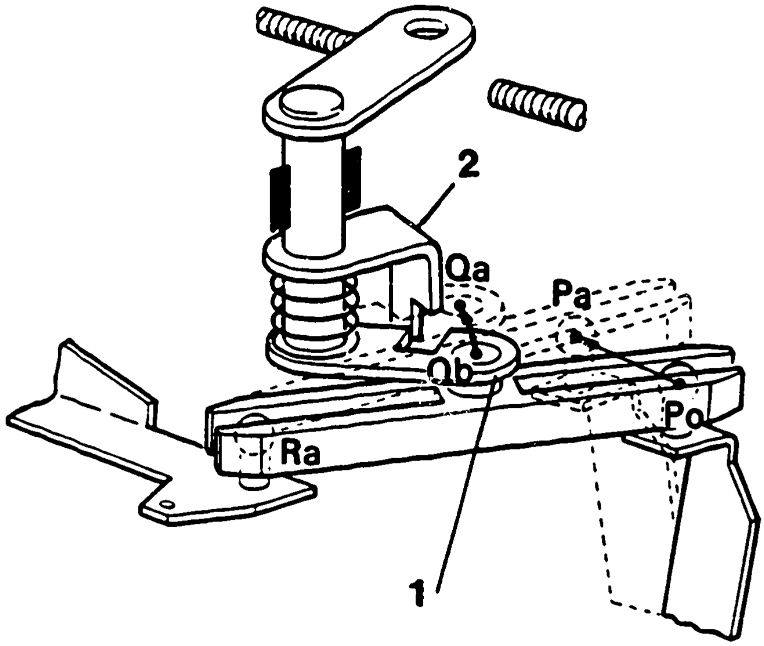


Fig. 10

1 = Support lever
2 = L-type bell crank

If the control lever is moved further in the direction of the maximum-speed adjusting screw, the bell crank moves away from the support lever. If the engine is started in this condition, there is an increase in the speed of the fuel-injection pump and the centrifugal force finally exceeds the sum total of the forces of the idle spring and governor spring. The outward deflection of the flyweights results in movement of the tensioning lever and the guide lever which, with increasing engine speed, produces a shift in the spherical pin from Po to Pa.

(continued)

The movement of the variable-fulcrum lever coincides with the turning of the support lever about Ra of the control-rod-end spherical pin, with the force of the return spring (2) acting on the support lever. The pivot of the variable-fulcrum lever shifts as a consequence towards Qb.

The pump speed reaches Na if the spherical pin of the guide lever reaches Pa. At the same time, the pivot of the variable-fulcrum lever is shifted towards Qa where the bell crank and the support lever make contact with one another (Fig. 10).

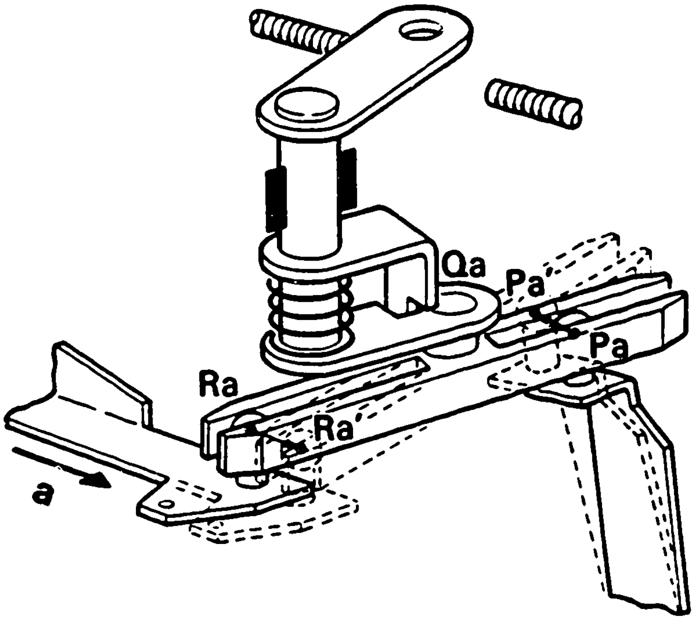


Fig. 11

a = Direction of reduced delivery

If the engine speed exceeds Na´, the flyweight stroke reaches La´ and Pa of the guide-lever spherical pin is shifted to Pa´. In this instant, the variable-fulcrum lever rotates around Qa, whereas the control rod moves from Ra to Ra´, so as to reduce the delivery (Fig. 11).

The governor regulates the engine speed by shifting the control rod in the direction of increased delivery, with the pivot of the variable-fulcrum lever being kept variable as soon as the engine speed increases as of the value at which the pump speed Na is in equilibrium with the control-rod travel Ra.

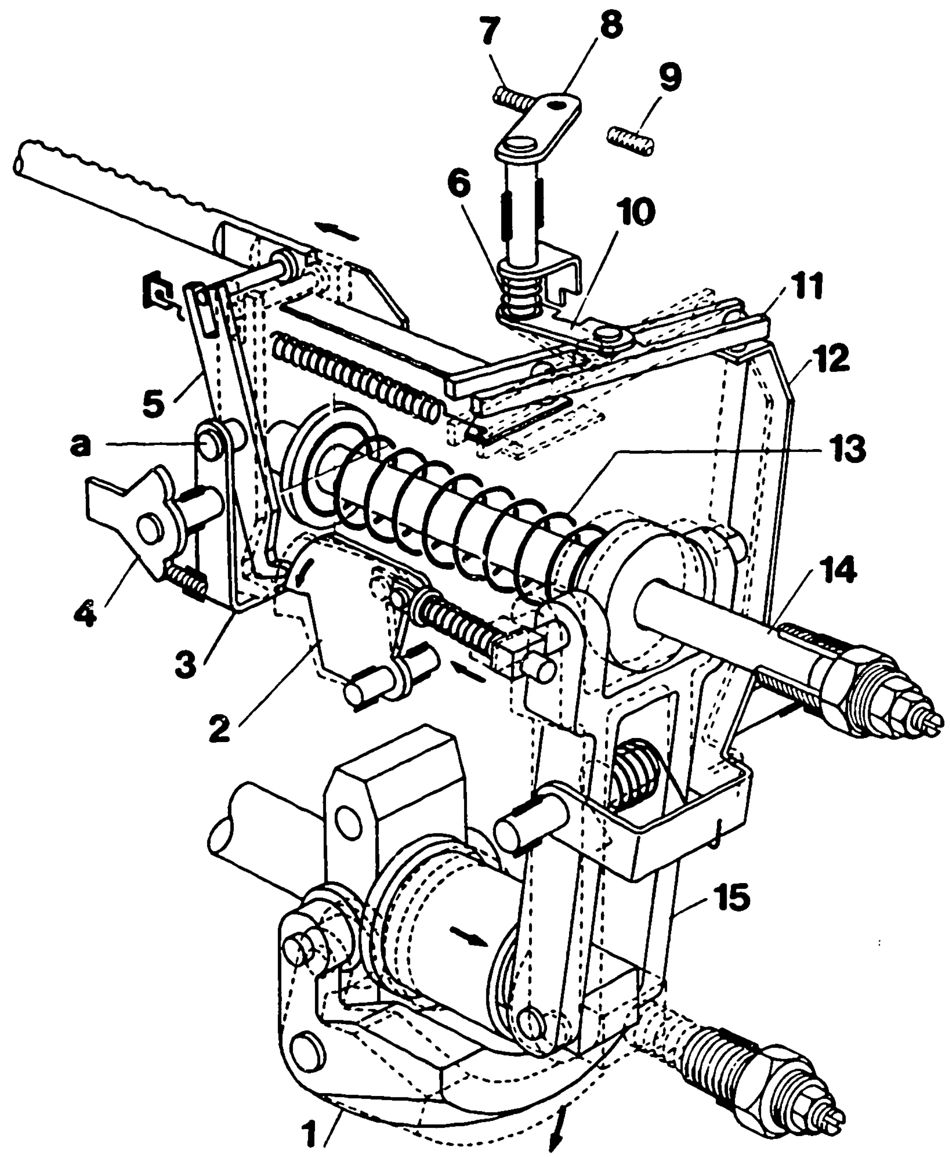


Fig. 12

Adjustment of the full-load control-rod travel by torque-control edge cam

1 = Flyweight
2 = Torque-control edge cam
3 = U-lever
4 = Full-load adjustment lever
5 = Sensing lever
6 = Return spring (2)

7 = Maximum-speed adjusting screw
8 = Control lever
9 = Idle-speed adjusting screw
10 = Support lever
11 = Variable-fulcrum lever
12 = Guide lever

13 = Governor spring
14 = Governor shaft
15 = Tensioning lever

a = Pivot S

The torque-control edge cam makes it possible to change the full-load position of the control rod. In this process, the delivery is increased or reduced in line with the pump speed which changes with engine speed. The torque-control edge cam was developed, so as to reduce exhaust emissions at full load and with a view to optimizing the torque characteristic and fuel consumption. If the control lever is moved such that it makes contact with the maximum-speed adjusting screw, whilst the engine speed is in excess of idling speed, there is a change in delivery. At the same time, the sensing lever rotates about S - the pivot of the U-lever - and the lowest part of the sensing lever makes contact with the torque-control edge cam. This results in regulation of the control-rod movement as illustrated in Fig. 12 (solid line).

Under these conditions, the return spring (2) acts on the spherical pin on the control-rod end, so as to turn the variable-fulcrum lever. The spherical pin on the guide lever acts as fulcrum.
Accordingly, the sensing lever makes contact with the torque-control edge cam.
Afterwards, if there is a gradual increase in pump speed, the tensioning lever turns the edge cam in a counter-clockwise direction (dashed line in Fig. 12) with the aid of the connecting rod attached to the upper end of the tensioning lever. The position of the torque-control edge cam is a function of engine speed. The edge of the sensing lever makes contact with the edge cam and thus regulates the full-load control-rod setting. This torque-control mechanism can be used with numerous engines, since the profile of the edge cam can be specially designed in line with the full-load fuel requirement of the individual engines.

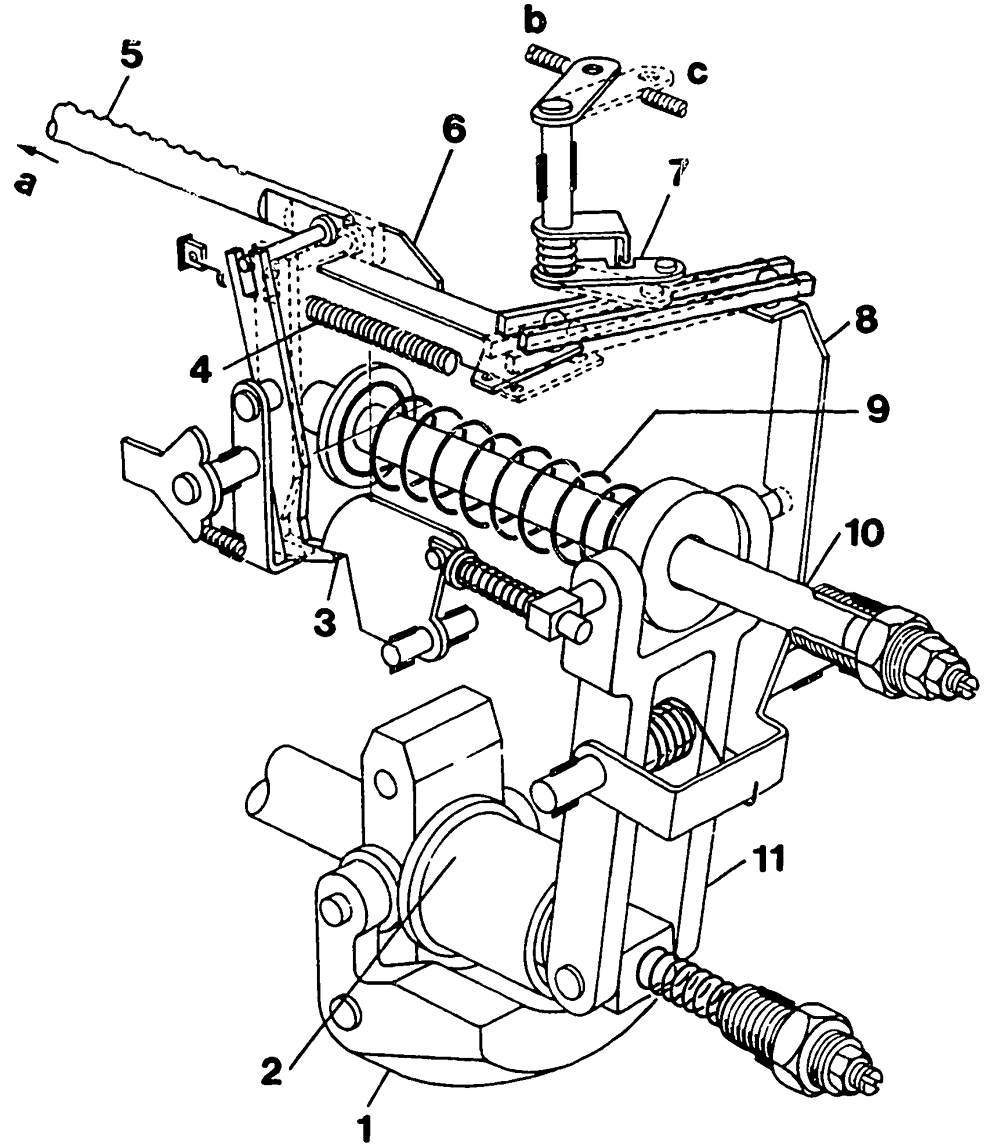


Fig. 13

Excess-fuel starting device

1 = Flyweight
2 = Sleeve
3 = Edge-cam shoulder
4 = Starting spring
5 = Control rod
6 = Connecting link

7 = Support lever
8 = Guide lever
9 = Governor spring
10 = Governor shaft
11 = Tensioning lever

a = Direction of increased delivery
b = Maximum-speed position
c = Idle-speed position

Excess-fuel starting device

When the engine is not running, the starting spring acts on the tensioning lever by way of the variable-fulcrem lever and the guide lever, thus minimizing the flyweight stroke and turning the torque-control edge cam in a clockwise direction. The torque-control edge cam features a shoulder. If the control lever is moved out of the idle-speed position (dashed line) into the maximum-speed position (solid line) when both the clamping lever and the torque-control edge cam are in the condition just described, the control rod is shifted in the direction of increased delivery by means of the support lever. In this process, the bottom edge of the sensing lever comes into contact with the shoulder of the torque-control edge cam, with the result that the path indicated by the solid line in Fig. 13 is covered.

As a consequence, the full-load position of the control rod changes in the direction of the excess-fuel position.
If the control lever is returned to the idle position after starting the engine, the variable-fulcrum lever pulls back the control rod, thus causing the shoulder of the torque-control edge cam to release the lower edge of the sensing lever.

Important:

> **Do not rev up engine immediately after starting, as otherwise the shoulder of the torque-control edge cam does not release the sensing lever and the control function of the governor is dangerously impaired.**

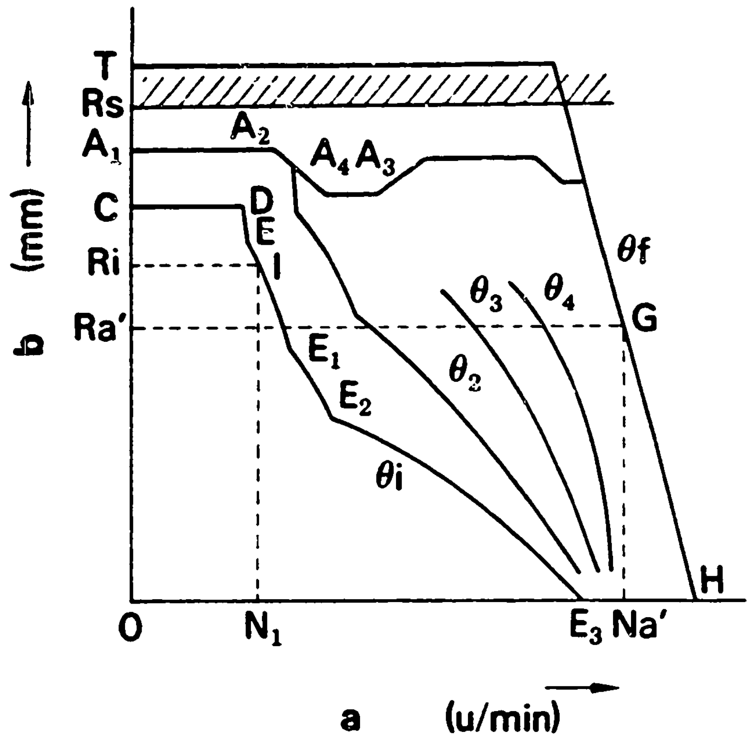


Fig. 14

a = Pump speed
b = Control-rod travel

Map of mechanical governor, type RLD (K)

Fig. 14 shows the governor map of the type RLD-K mechanical governor with speed-control lever in position θ.

Map of mechanical governor, type RLD (K) (continued)

1. Idle position of control lever (θi).

   C-D: The initial tension of the starting spring exceeds the centrifugal force (flyweight stroke 0).

   D-E: The starting-spring force yields to the centrifugal force and the control rod is shifted.

   E-E1: Range of engine-speed control by idle spring; 1 indicates the idling point.

   E-E3: Range of engine-speed control by idle spring and governor spring.

   $\theta 2$, $\theta 3$ and $\theta 4$ are governor characteristic curves obtained with the control lever in three different positions. The characteristic curve becomes shallower as the control lever approaches the maximum-speed side.

2. Maximum-speed regulation of control lever (θf)

   A1-A2F: Range of engine-speed control by torque-control edge cam.

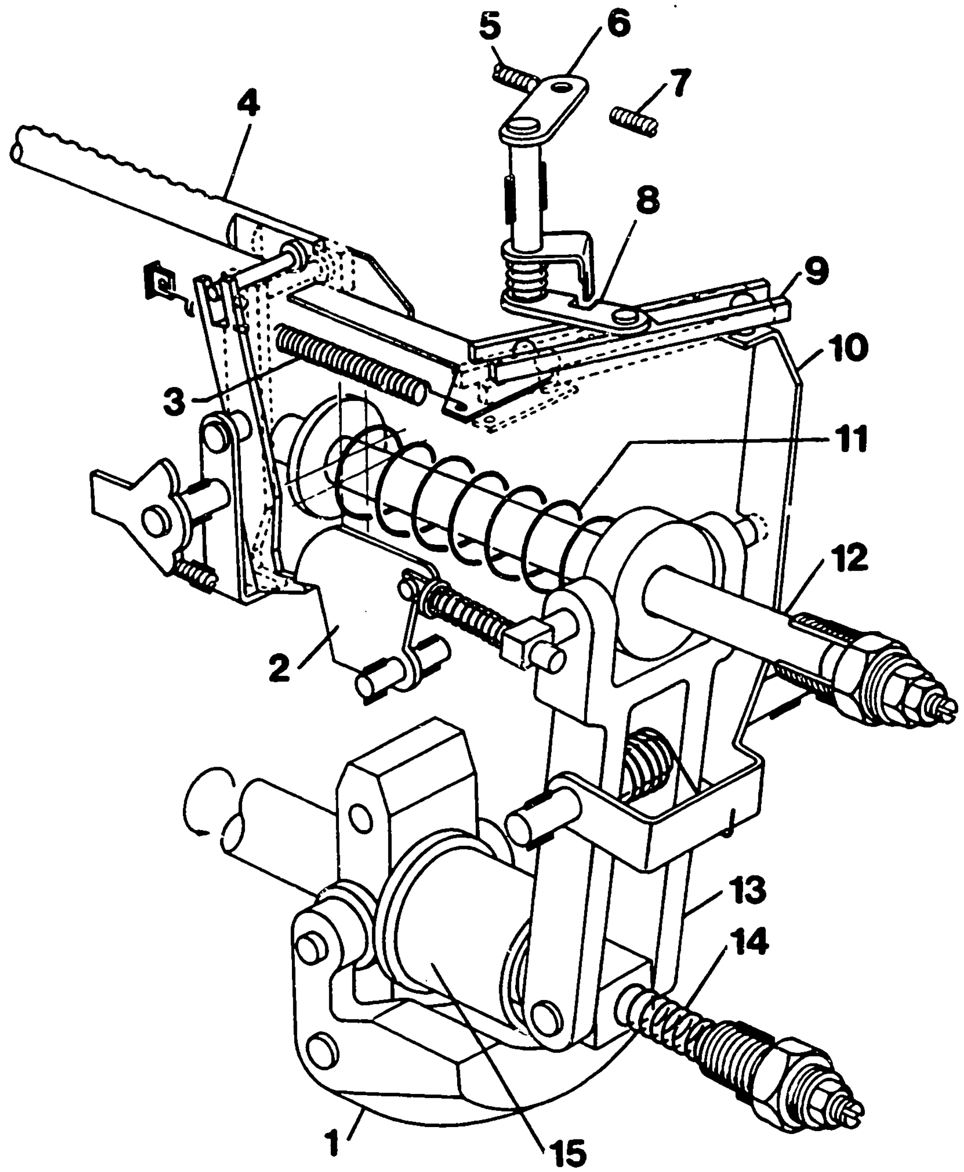
   F-G-H: Range of engine-speed control by governor spring. The point G designates the high idling speed.

Map of mechanical governor, type RLD (K) (continued)

3. Increased delivery on starting.

   If the engine speed is increased after the control lever has been moved to the maximum-speed position with the engine stopped:

   T-U: Represents the range of excess fuel for starting, which is obtained if the sensing lever engages behind the shoulder of the torque-control edge cam. The control rod is however normally held at Rs by the control-rod stop.



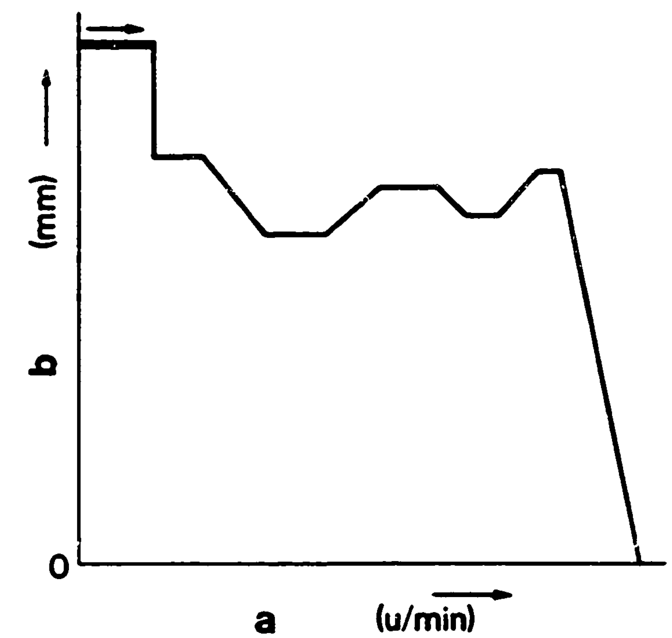


Fig. 15

1 = Flyweight
2 = Torque-control edge cam
3 = Starting spring
4 = Control rod
5 = Maximum-speed adjusting screw
6 = Control lever
7 = Idle-speed adjusting screw
8 = Support lever
9 = Variable-fulcrum lever
10 = Guide lever
11 = Governor spring
12 = Governor shaft
13 = Tensioning lever
14 = Idle spring
15 = Sleeve

a = Pump speed
b = Control-rod travel

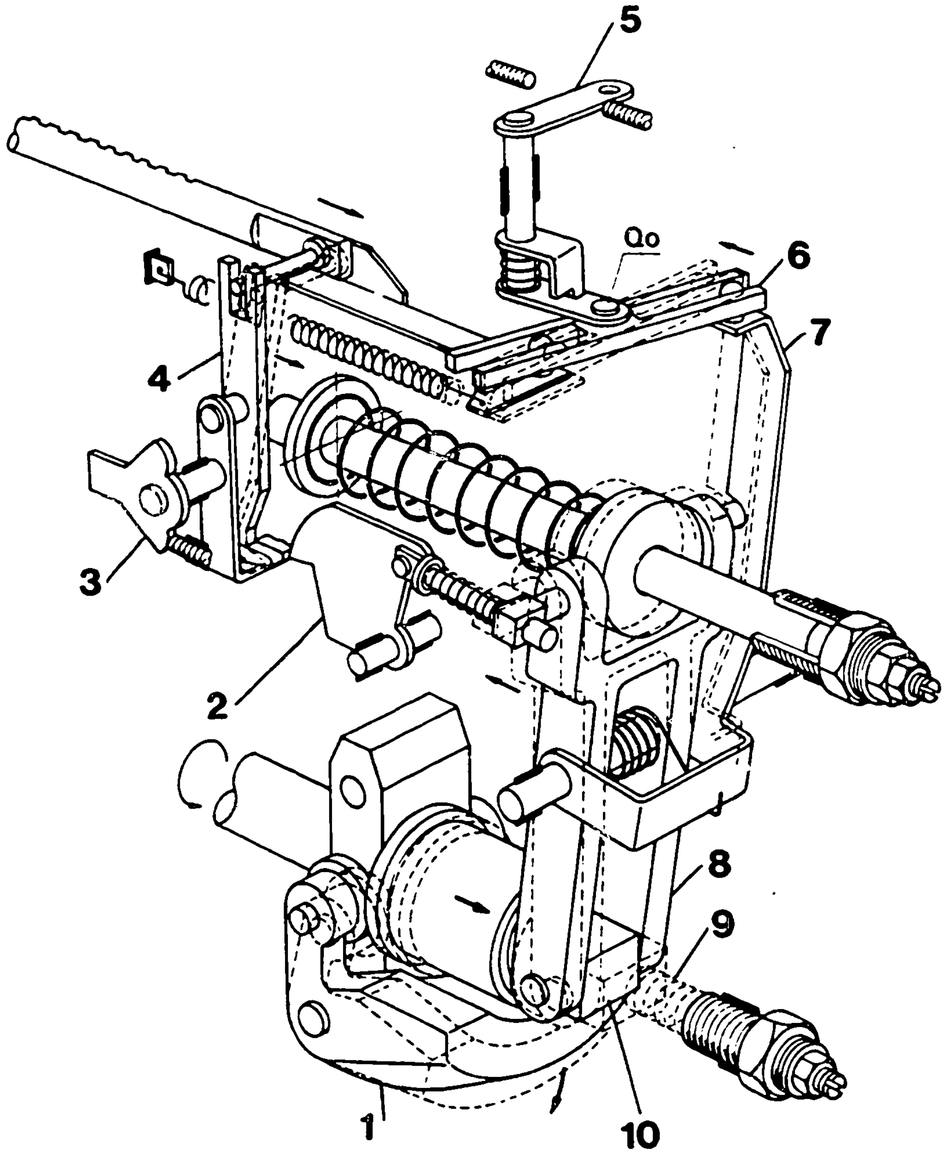
WORKING METHOD IN OPERATION

Starting engine

Starting engine

The flyweights are kept closed when the engine is stopped. As explained initially, neither the idle spring nor the governor spring is normally pressed together; there is no initial tension.
If the driver depresses the accelerator pedal as far as it will go, the speed-control lever - which is connected to the accelerator pedal by means of a rod - makes contact with the maximum-speed adjusting screw. At the same time, the variable-fulcrum lever also moves and shifts the control rod in the direction of increased delivery until the excess fuel for starting is attained.
The edge of the sensing lever engages behind the shoulder of the torque-control edge cam, thus regulating the engine starting fuel delivery.

The control rod then moves beyond its full-load position and finally reaches the starting-fuel-delivery position set at the control-rod stop. If the accelerator pedal is released after starting the engine, the speed-control lever moves back to the idle-speed adjusting screw. The control rod then moves in the direction of reduced delivery and the shoulder of the torque-control edge cam releases the edge of the sensing lever. If the control lever is subsequently actuated, the engine starting fuel delivery is not increased.



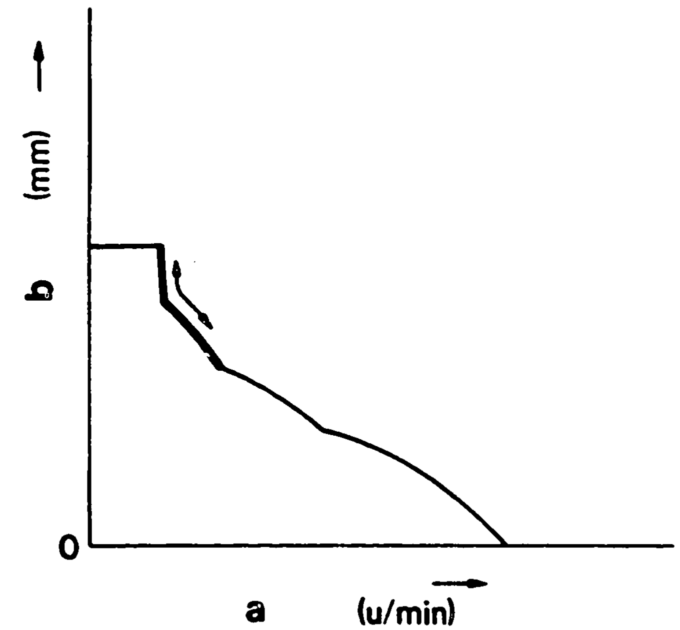


Fig. 16

1 = Flyweight
2 = Torque-control edge cam
3 = Full-load adjustment lever
4 = Sensing lever
5 = Control lever

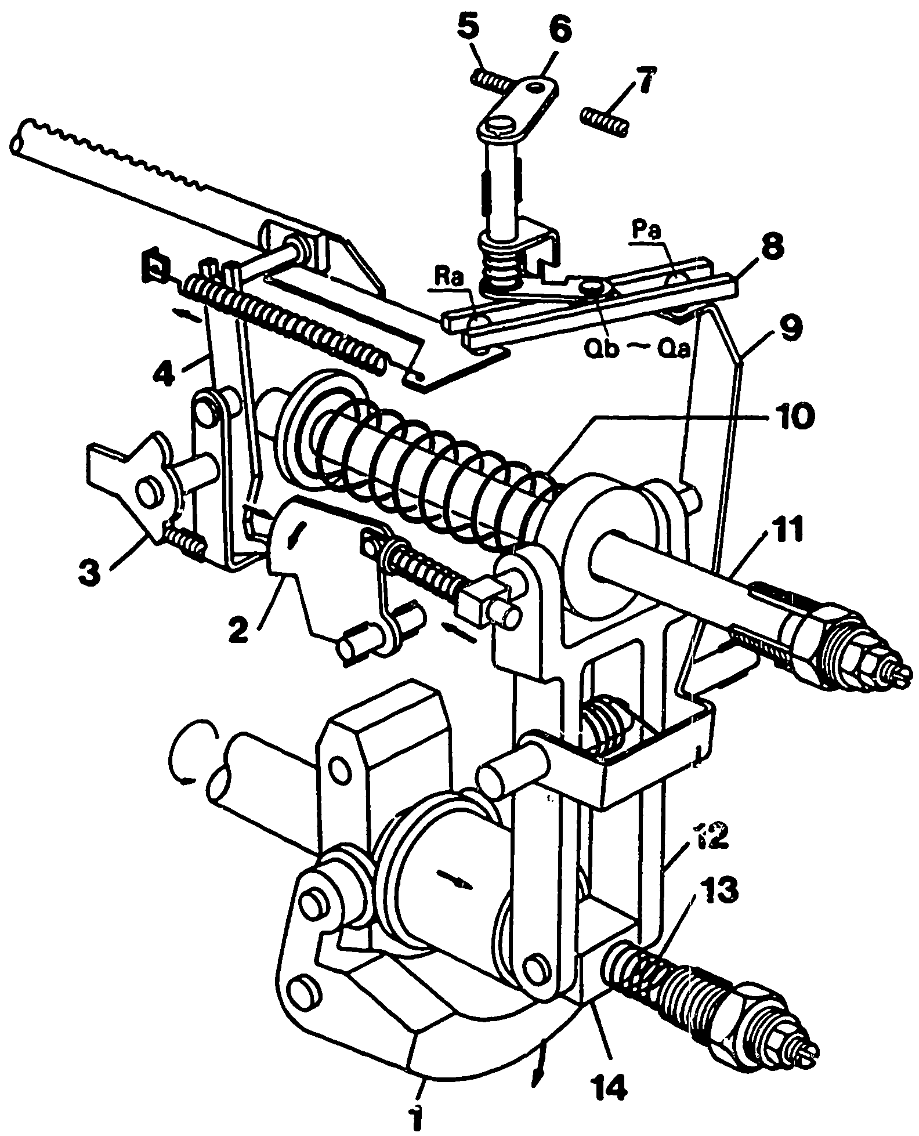
Idle-speed regulation

6 = Variable-fulcrum lever
7 = Guide lever
8 = Tensioning lever
9 = Idle spring
10 = Sliding bolt

a = Pump speed
b = Control-rod travel

Idle-speed regulation

If the speed-control lever returns to the idle position once the engine has started, then the pivot of the variable-fulcrum lever moves back to the idle position Qo. The governor is then ready for the start of idle-speed regulation. If the engine speed decreases, there is also a reduction in the centrifugal force, which yields to the idle-spring force and causes the flyweights to move inwards. The control rod then moves about the pivot Qo of the variable-fulcrum lever in the direction of increased delivery, so as to stop the engine cutting out. If the engine speed increases, then the idle-spring force becomes less than the centrifugal force, with the result that the control rod is pulled back, so as to reduce the delivery (dashed line in Fig. 16) and thus to reduce the engine speed. The governor therefore stabilizes the engine idle and makes use of the equilibrium between the centrifugal force and the sum total of the starting-spring force and idle-spring force to offset engine-speed fluctuations.
If the engine is idling, the sensing lever does not make contact with the torque-control edge cam.



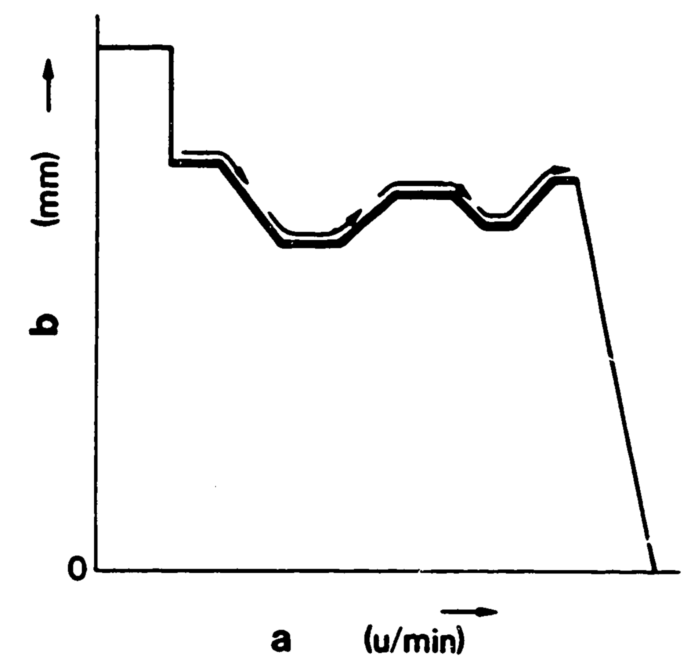


Fig. 17

Control of full-load delivery by torque-control edge cam

1 = Flyweight
2 = Torque-control edge cam
3 = Full-load adjustment lever
4 = Sensing lever
5 = Maximum-speed adjusting screw
6 = Control lever
7 = Idle-speed adjusting screw

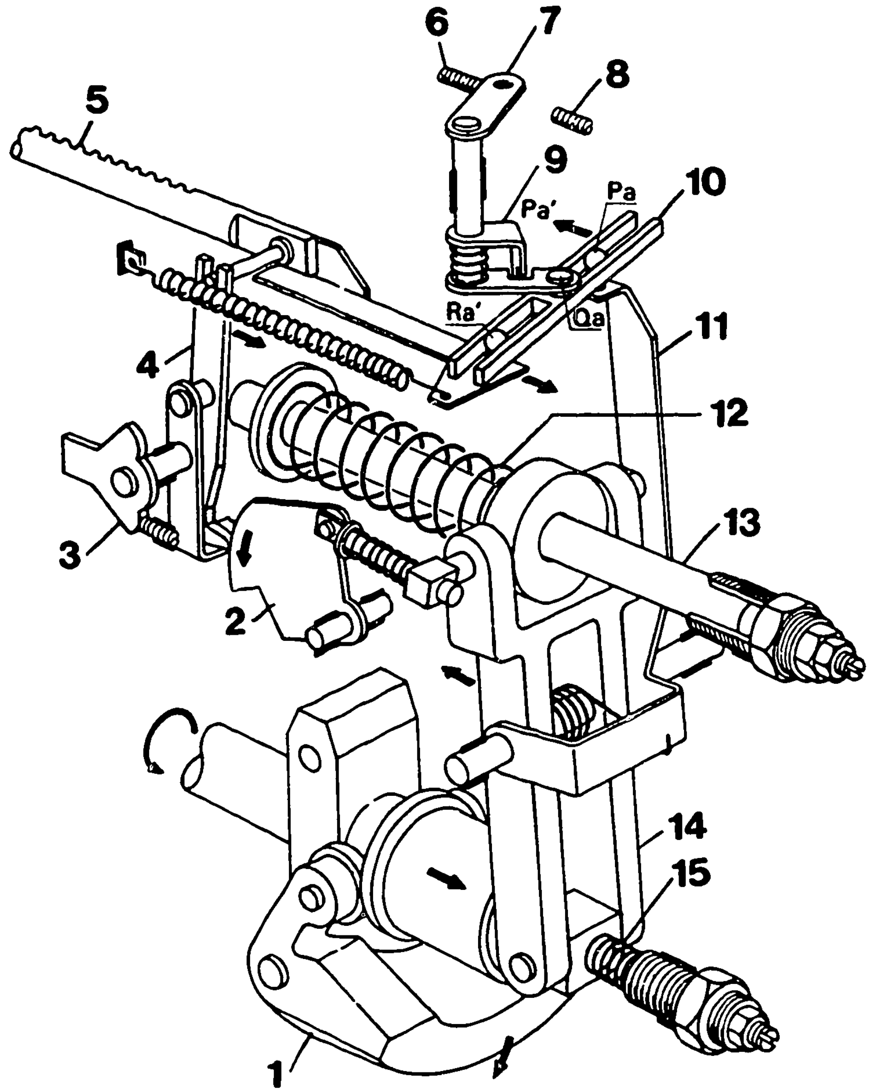
8 = Variable-fulcrum lever
9 = Guide lever
10 = Governor spring
11 = Governor shaft
12 = Tensioning lever
13 = Idle spring
14 = Sliding bolt

a = Pump speed
b = Control-rod travel

Control of full-load delivery by torque-control edge cam

If the accelerator pedal is depressed with the engine running under load until the control lever makes contact with the maximum-speed adjusting screw, the variable-fulcrum lever moves about the spherical pin of the guide lever and moves the control rod to the full-load position (Ra). The sensing lever turns until its lower edge makes contact with the torque-control edge cam. Subsequent engine-speed fluctuations cause the tensioning lever to pivot about the tensioning-lever shaft. The torque-control edge cam rotates accordingly on its shaft.

As soon as the torque-control edge cam moves, the edge of the sensing lever follows the surface of the torque-control edge cam, with the result that the position of the control rod is altered to regulate the delivery. If the engine speed changes, the tensioning lever swivels, thus shifting the spherical pin at Pa on the guide lever and moving the position of the pivot Q of the variable-fulcrum lever. As a result of the movement of the torque-control edge cam, the control rod is moved with the aid of the sensing lever.



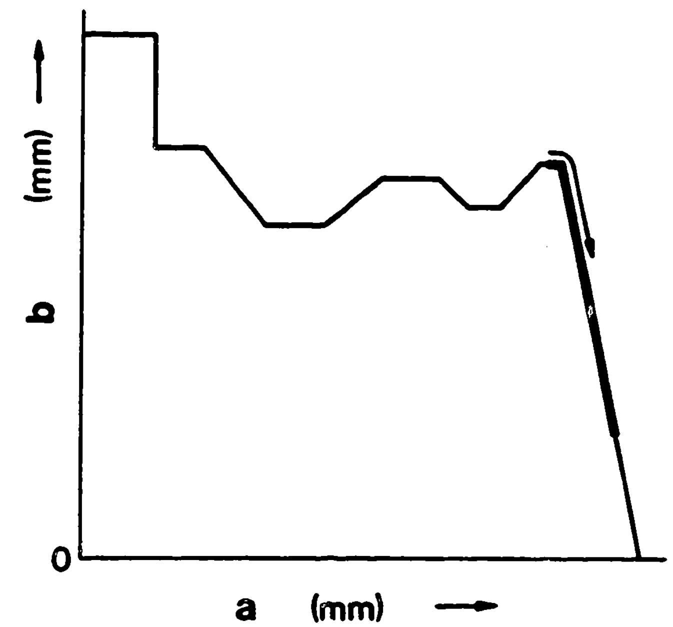


Fig. 18

Full-load speed regulation

1 = Flyweight
2 = Torque-control edge cam
3 = Full-load adjustment lever
4 = Sensing lever
5 = Control rod
6 = Maximum-speed adjusting screw
7 = Control lever
8 = Idle-speed adjusting screw

9 = Bell crank
10 = Variable-fulcrum lever
11 = Guide lever
12 = Governor spring
13 = Governor shaft
14 = Tensioning lever
15 = Idle spring

a = Pump speed
b = Control-rod travel

Full-load speed regulation

When the control lever is in contact with the maximum-speed adjusting screw, the engine speed can be increased, whilst the fuel delivery is regulated by the torque control/edge cam/sensing lever mechanism.

If the engine speed continues to increase, and the support lever makes contact with the bell crank on the control-lever shaft, the spherical pin of the guide lever moves from Pa to Pa' executing a swivel motion around the pivot Qa of the variable-fulcrum lever. As a result, the control rod is pulled back in the direction of reduced delivery. This procedure is known as full-load speed regulation. With full-load speed regulation, the edge of the sensing lever is also disengaged at the torque-control edge cam.

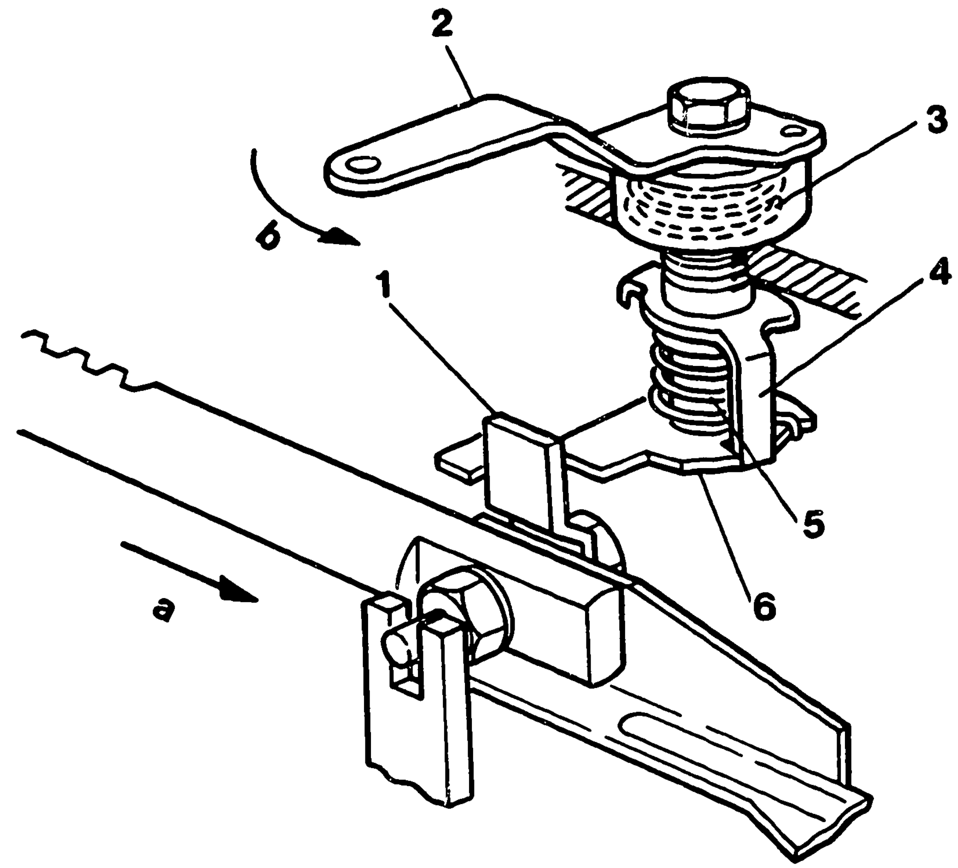


Fig. 19

a = Direction of reduced delivery
b = Shutoff device

1 = Plate of shutoff device
2 = Stop lever
3 = Return spring
4 = Support lever
5 = Return spring
6 = Inner stop lever

ATTACHMENTS

Shutoff device

Design

In a manner similar to other governors, the type RLD (K) mechanical governor can be equipped with a shutoff device. The shutoff device is installed on the top of the governor housing as shown in Fig. 19.

Mode of operation

When the stop lever is disengaged, the inner stop lever cannot make contact with the plate of the shutoff device (the stop lever is held in the engine shutoff position by a return spring). If the stop lever is turned towards the shutoff side with the fuel-injection pump running, the inner stop lever presses against the plate of the shutoff device, thus shifting the control rod into the zero-delivery position and shutting off the engine.
Given this condition, the governor can normally shut off the engine irrespective of the engine speed and quantity injected. The operating range of this inner stop lever is approximately 40°, however the effective range is some 30° from the normal position.

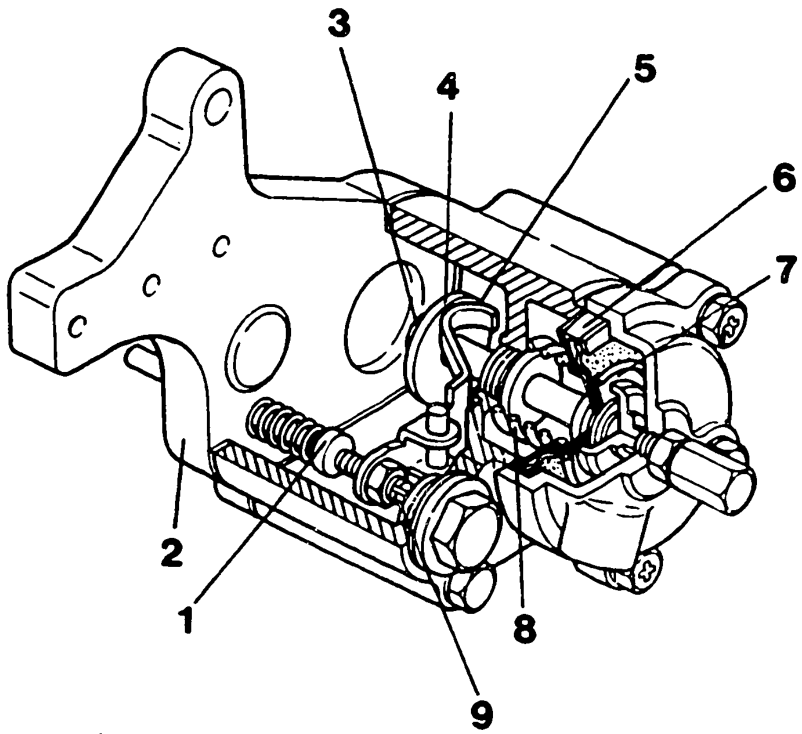


Fig. 20

1 = Thrust pin B
2 = Spacer plate
3 = Thrust pin A
4 = Disc
5 = Lever
6 = Diaphragm
7 = Pressure chamber
8 = Compression spring
9 = Adjusting screw

Manifold-pressure compensator

Design

Fig. 20 shows a sectional view of the manifold-pressure compensator.

Mode of operation

As the engine speed increases, the turbocharger starts to convey compressed air into the pressure chamber of the manifold-pressure compensator. If the charge-air pressure exceeds the initial tension of the compression spring, the diaphragm and thrust pin A move towards the drive end.
The movement of the thrust pin A turns the lever in a counter-clockwise direction, with the result that the thrust pin B follows the lever movement and moves away from the drive end. The stroke of the manifold-pressure compensator is set by way of an adjustment spring and an adjusting screw at the thrust pin B. The U-lever is then turned in a counter-clockwise direction by a return spring. The U-lever thus follows the movement of the thrust pin B. This results in the center pivot of the sensing lever moving in a counter-clockwise direction and the sensing lever shifting the control rod in the direction of the drive end (direction of increased delivery), since the edge of the sensing lever makes contact with the torque-control edge cam (Fig. 21).

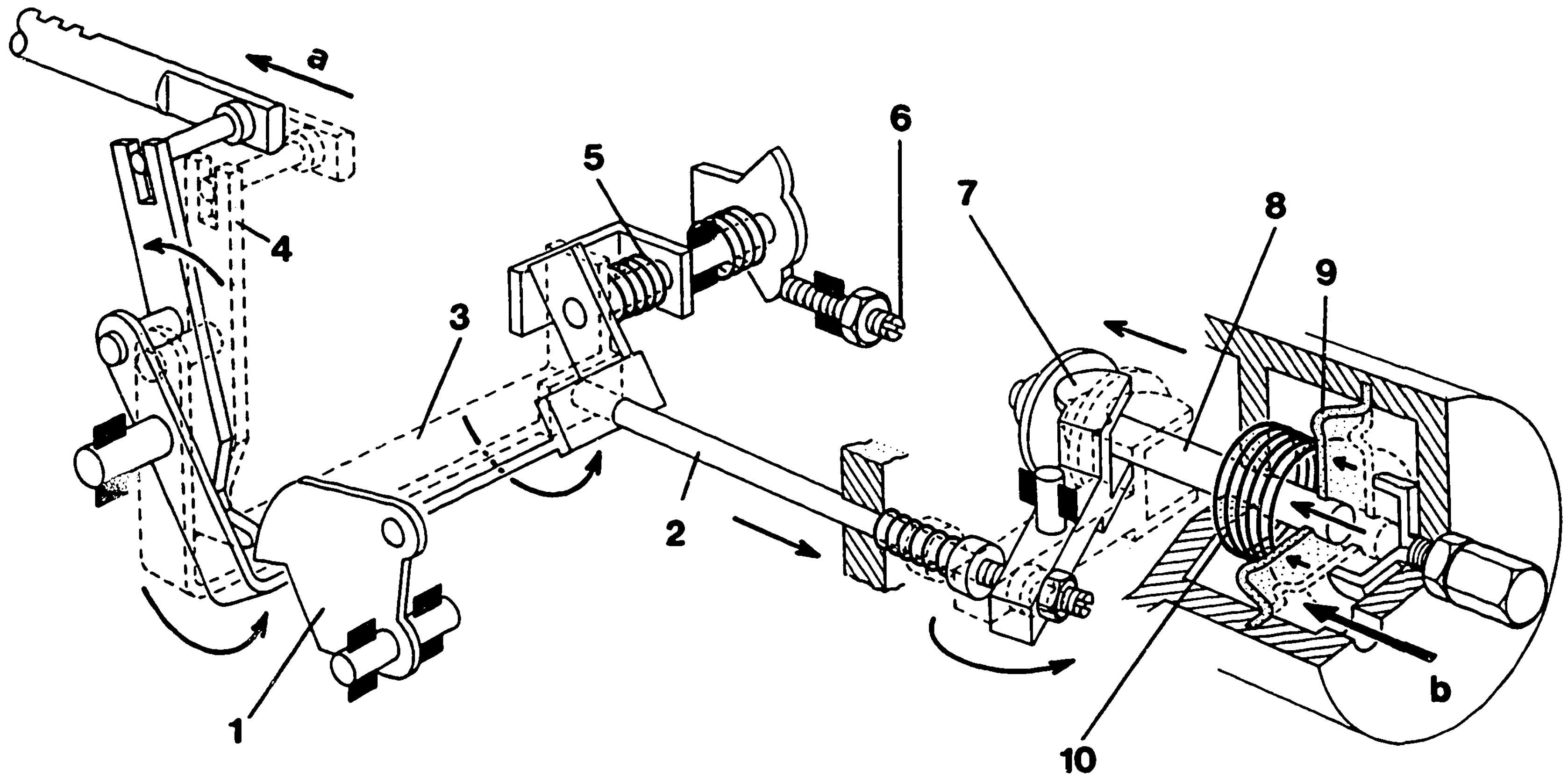


Fig. 21

1 = Torque-control edge cam
2 = Thrust pin B
3 = U-lever
4 = Sensing lever
5 = Return spring
6 = Full-load adjusting screw
7 = Lever
8 = Thrust pin A
9 = Diaphragm
10 = Compression spring

a = Direction of increased delivery
b = Charge air

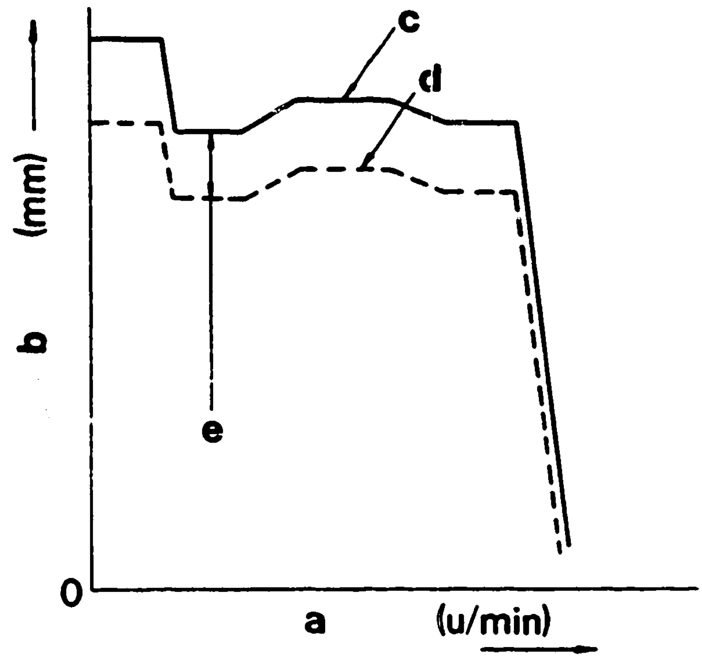
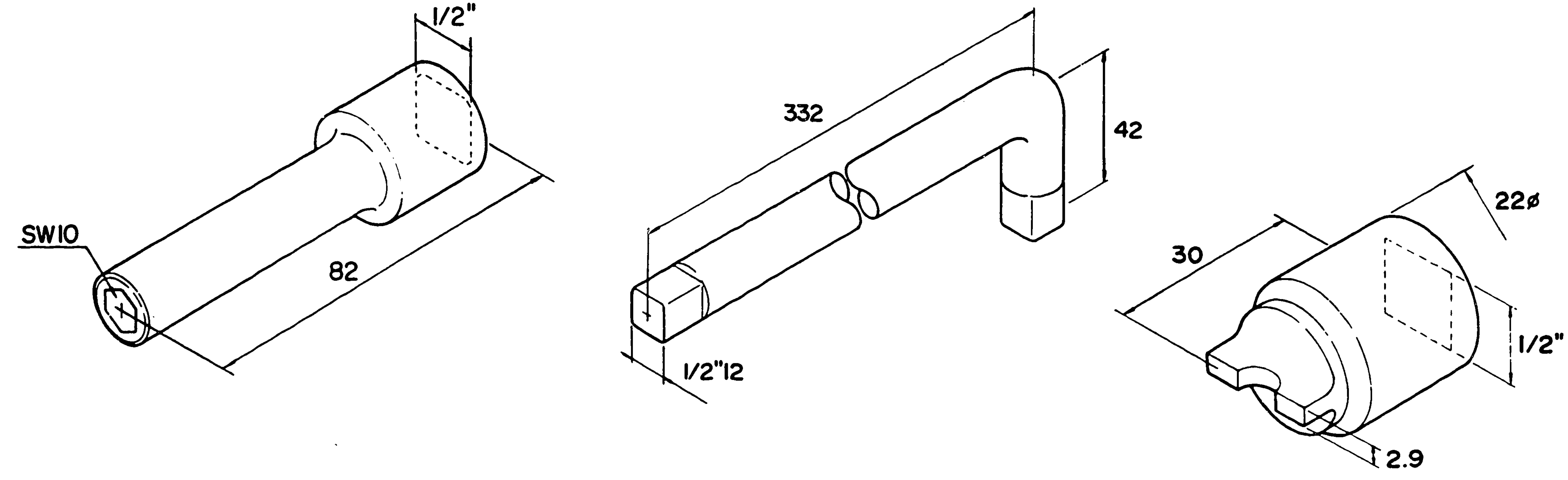


Fig. 22

a = Pump speed
b = Control-rod travel
c = Manifold-pressure compensator, functioning
d = Manifold-pressure compensator, not functioning
e = Stroke of manifold-pressure compensator

Fig. 22 illustrates the governor map of a fuel-injection pump equipped with manifold-pressure compensator.



1. 2. 3.

Fig. 23

1. Special socket wrench (commercially available)

2. Bell crank (commercially available)

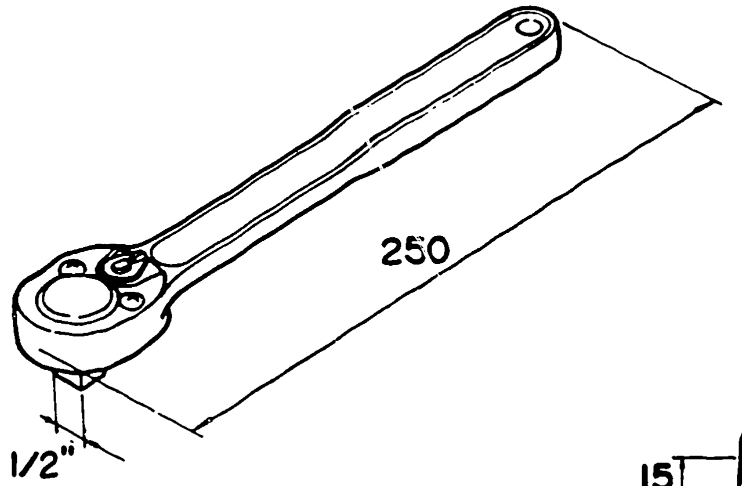
3. Special insert (KDEP 2626)

DISASSEMBLY

Special tools

Tools required for disassembly/assembly

The disassembly procedure for the mechanical governor, type RLD (K) is a function of the type of fuel-injection pump to which the governor is attached. This section describes disasembly of the governor attached to the type PES-A fuel-injection pump.



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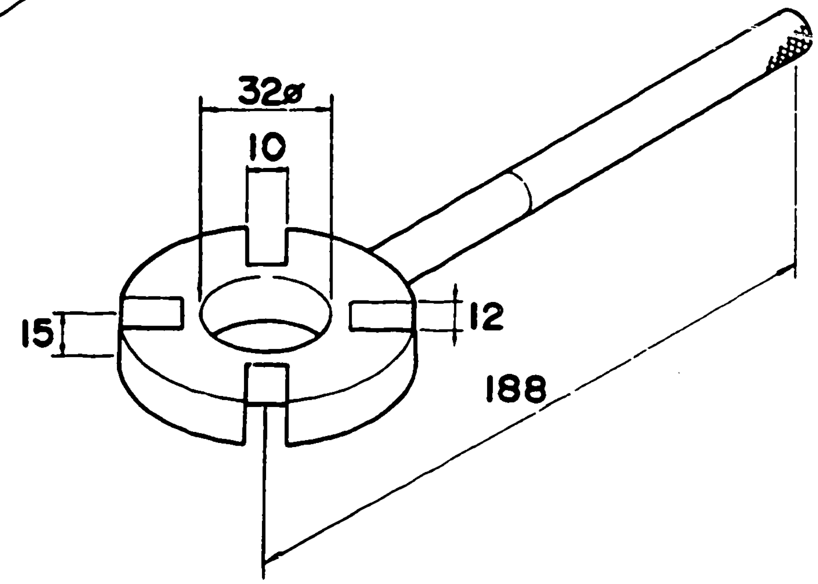

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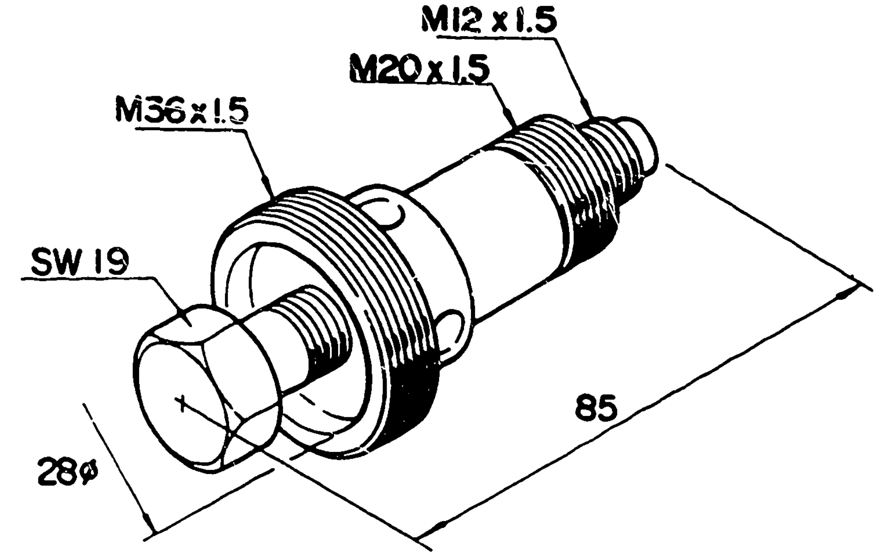


6.

Fig. 23-1

Special tools

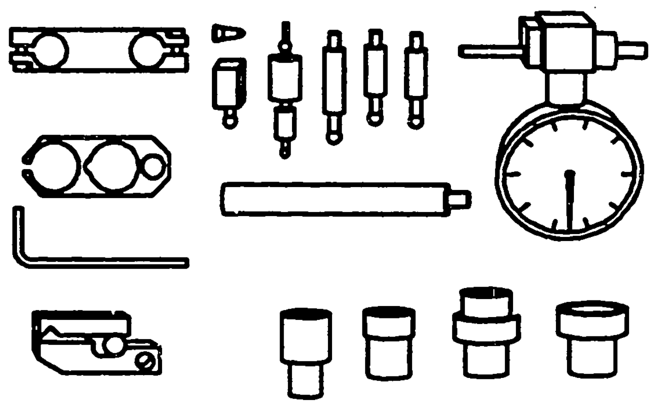
4. Reversible ratchet-handle
(commercially available)

5. Special wrench (KDEP 2906)

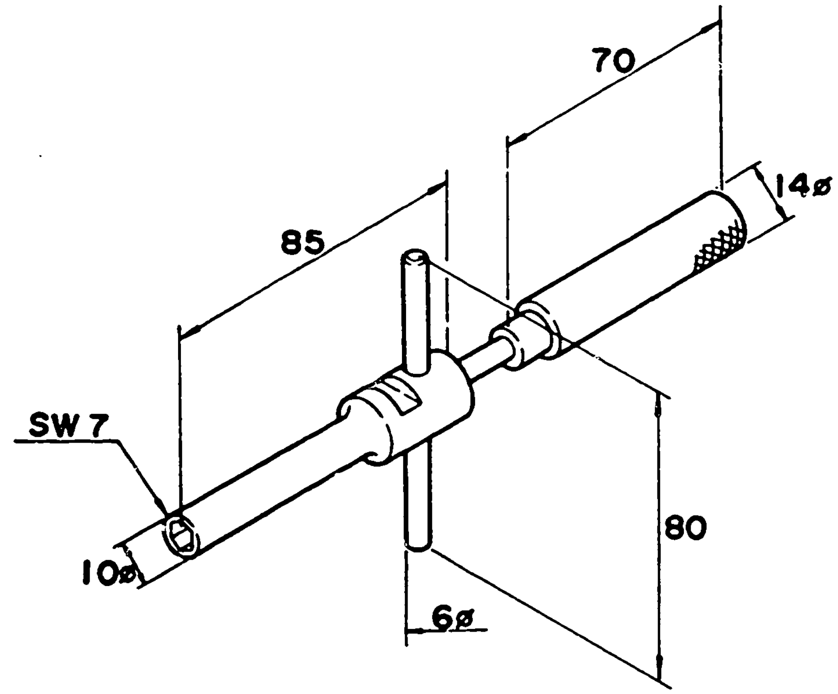
6. Puller (KDEP 2918)

The following standard tools are required in addition to these special tools:

Screwdriver, screwdriver for recessed-head screws, pointed pliers, wrench, wooden or plastic hammer, press, sliding caliper or depth gauge.



1.



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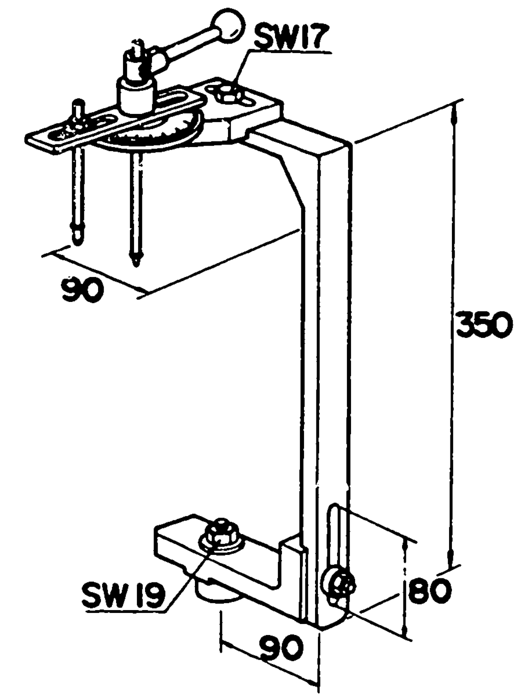


3.

Fig. 24

Adjustment tools

1. Measuring tool (1 688 130 130)

2. Special wrench (commercially available)

3. Setting device (KDDC 0018)

Adjustment tools

Following assembly, various adjustment operations must be performed on the governor. Use can be made of an injection-pump test bench for adjusting the type RLD (K) governor.

In addition, the above-listed special tools are needed for adjustment of the type RLD (K) mechanical governor.

Preparation for disassembly

Extreme care must be exercised when disassembling the type RLD-K mechanical governor. Before commencing work, make sure that the clamping device and workplace are clean. We further recommend noting down the governor settings beforehand; the above should include the position of each adjusting screw and lock washer when tightened. It is thus possible to compare the values prior to disassembly with the values determined following assembly and therefore to establish whether the governor is functioning properly again. Writing down the operating values and settings is also a valuable aid to fault elimination should it become necessary. Before commencing disassembly, remove all dust and deposits from the outside of the governor and the fuel-injection pump. The numbers given in brackets ( ) are the tool numbers and the item numbers listed in Fig. 128.

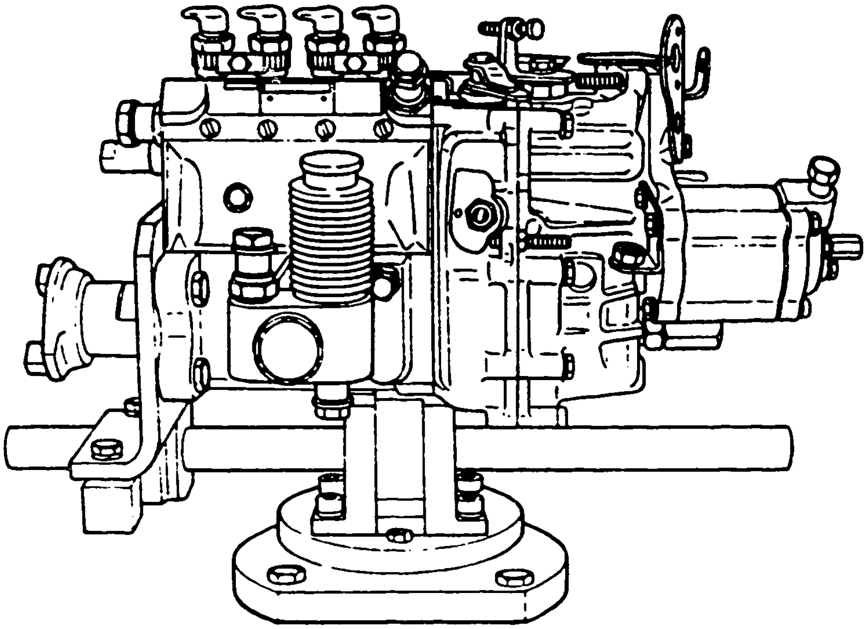


Fig. 25: Clamping fuel-injection pump in position

Disassembly procedure

The procedure described here refers to the type RLD (K) governor (with manifold-pressure compensator) attached to the type NP-PES 4 A fuel-injection pump.

1. Remove timing device and holder from fuel-injection pump. Then attach coupling (1 686 430 022) to camshaft.

2. Disengage return spring at speed-control lever.

3. Secure fuel-injection pump in position on universal vice.

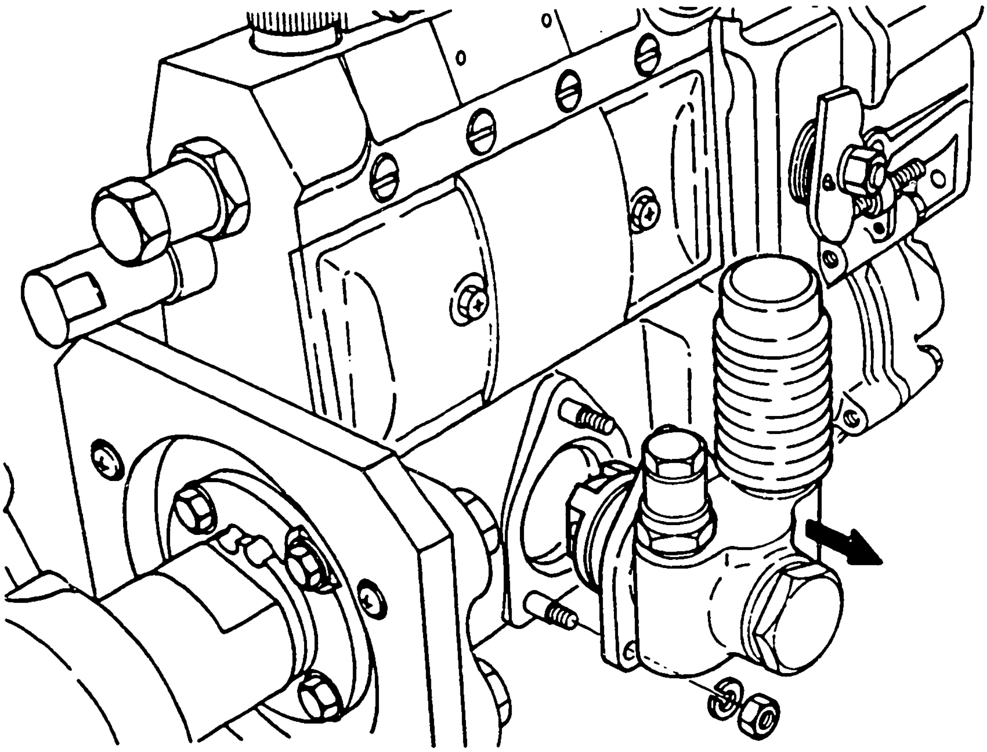


Fig. 26: Removing supply pump

4. Unscrew the three nuts used to secure the fuel supply pump and remove supply pump.

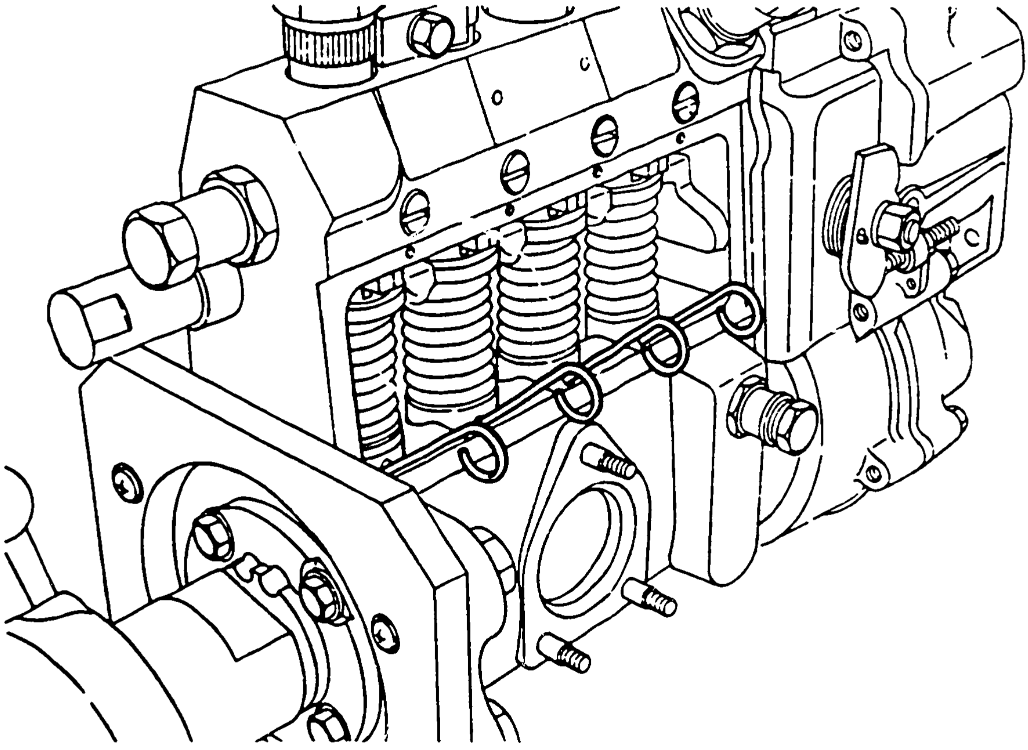


Fig. 27 Inserting roller-tappet holder

5. Remove pump cover plate and turn camshaft with special wrench (KDEP 2906). When the roller tappet reaches top dead center, insert roller-tappet holder (KDEP 2608) in tappet hole such that roller tappet can be lifted off cam.

6. Steps 7 - 9 describe removal of the manifold-pressure compensator. Proceed to step 10 if the governor has no manifold-pressure compensator.

7. Unscrew the three screws (10 mm) and the screw with which the two support brackets and the spacer plate of the manifold-pressure compensator are secured.

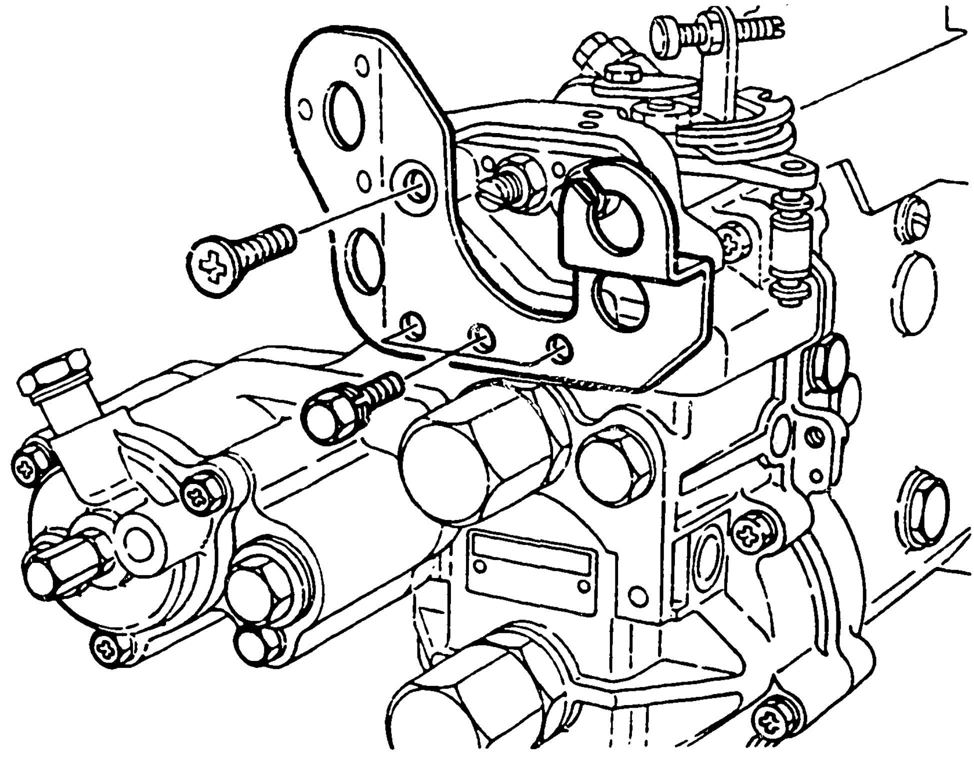


Fig. 28: Removing support bracket

8. Remove support bracket.

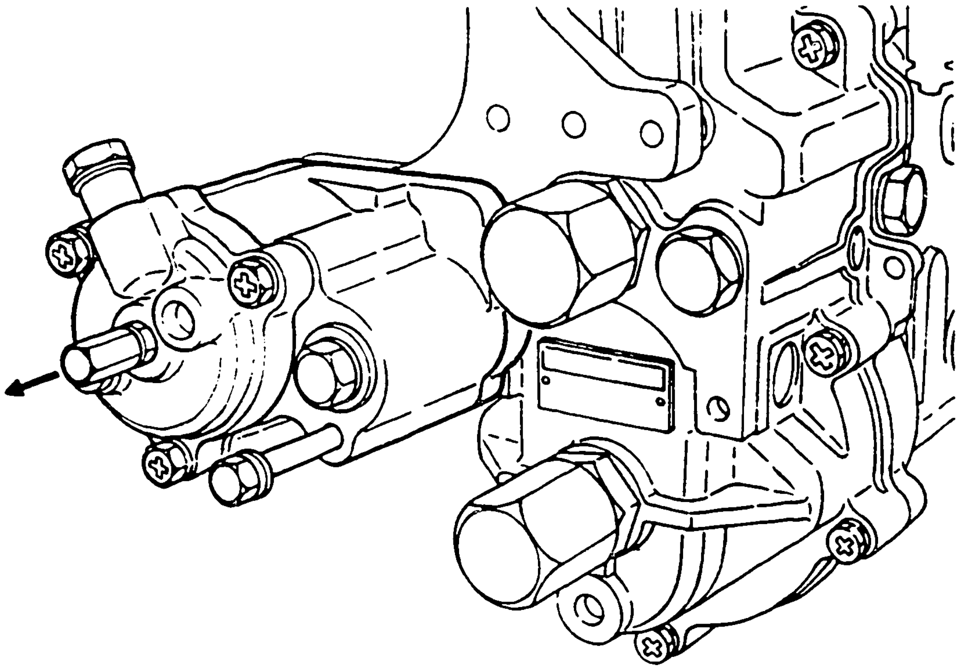


Fig. 29 Removing manifold-pressure compensator

9. Screw out screw beneath screw plug of adjustment opening in compensator; then remove manifold-pressure compensator from governor cover.
   Make sure that thrust pin is not bent.

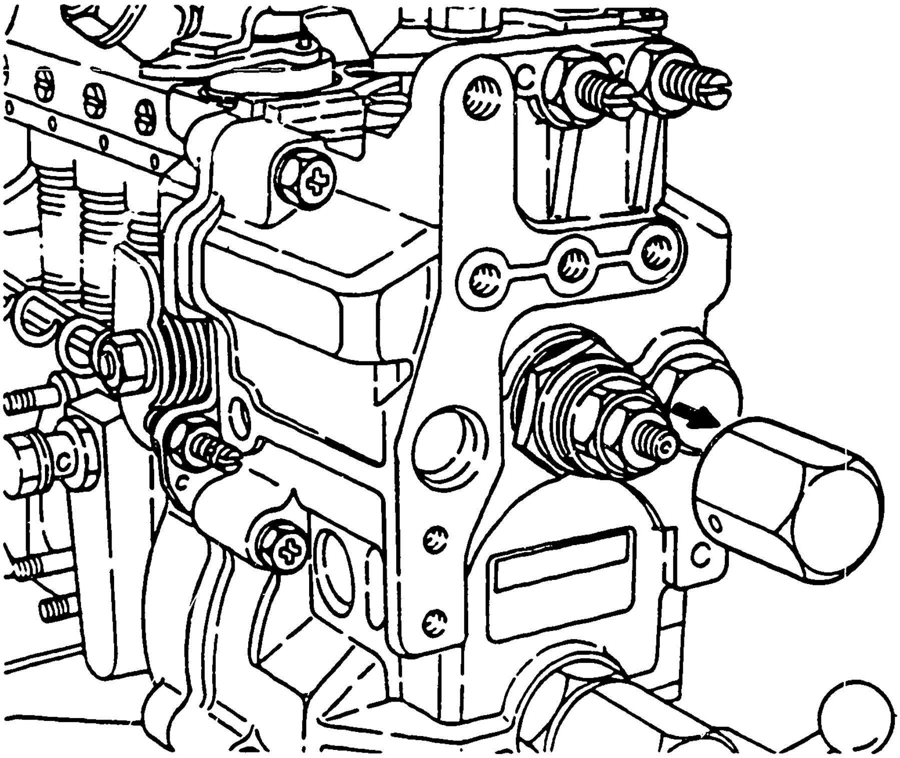


Fig. 30 Unscrewing cap nut

10. Unscrew cap nut (149).

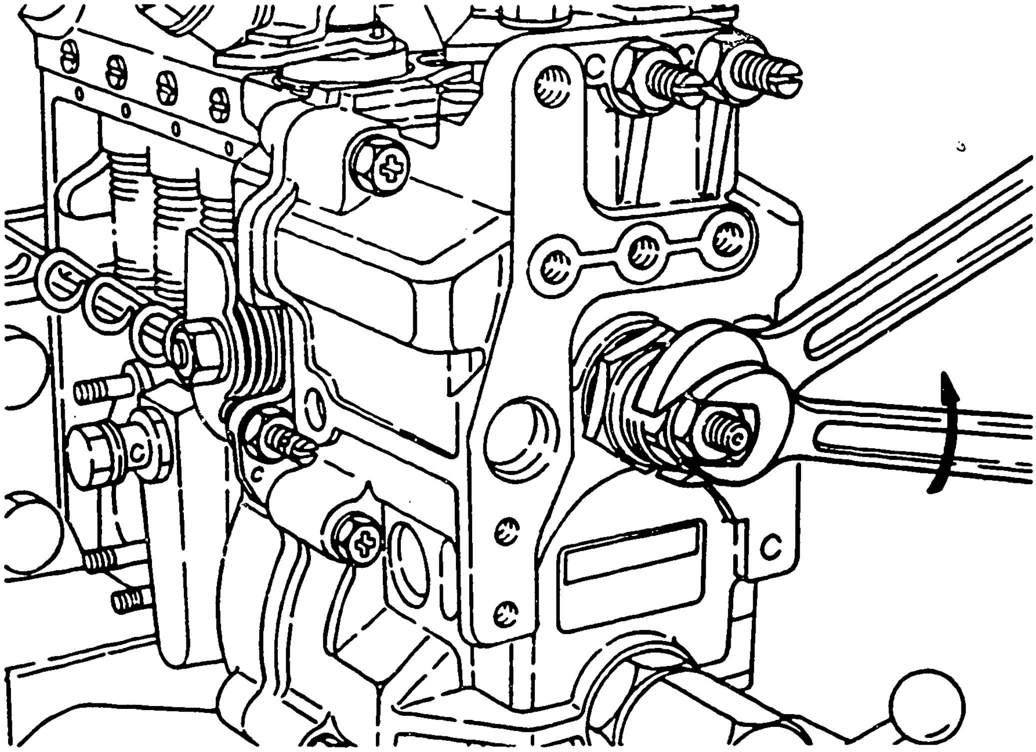


Fig. 31 Unscrewing lock nuts

11. Use two wrenches (13 and 19 mm) to unscrew two lock nuts (145 and 146) from governor shaft.

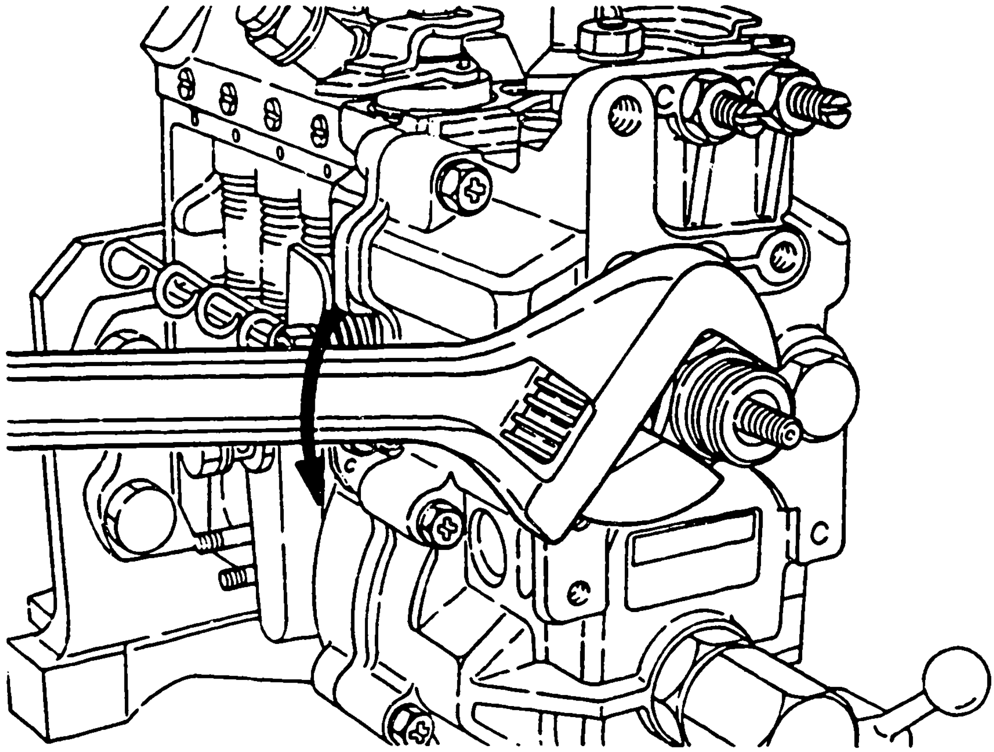


Fig. 32 Loosening lock nut

12. Loosen lock nut (147, 27 mm).

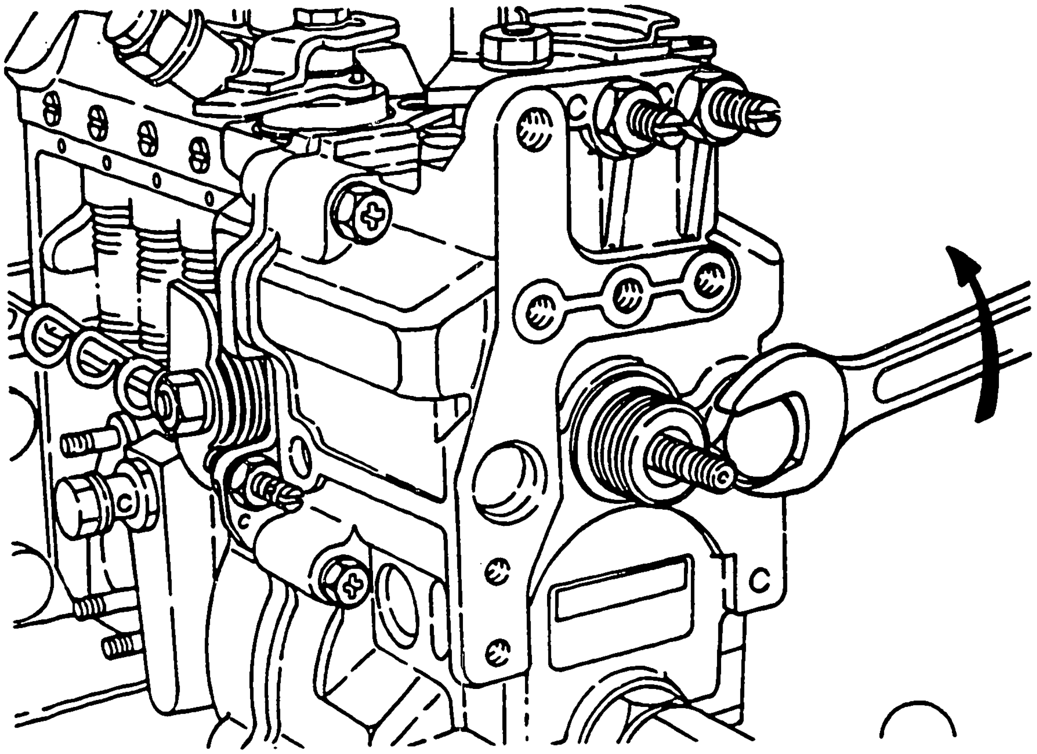


Fig. 33 Unscrewing screw plug

13. Use wrench (19 mm) to screw out screw plug (311).

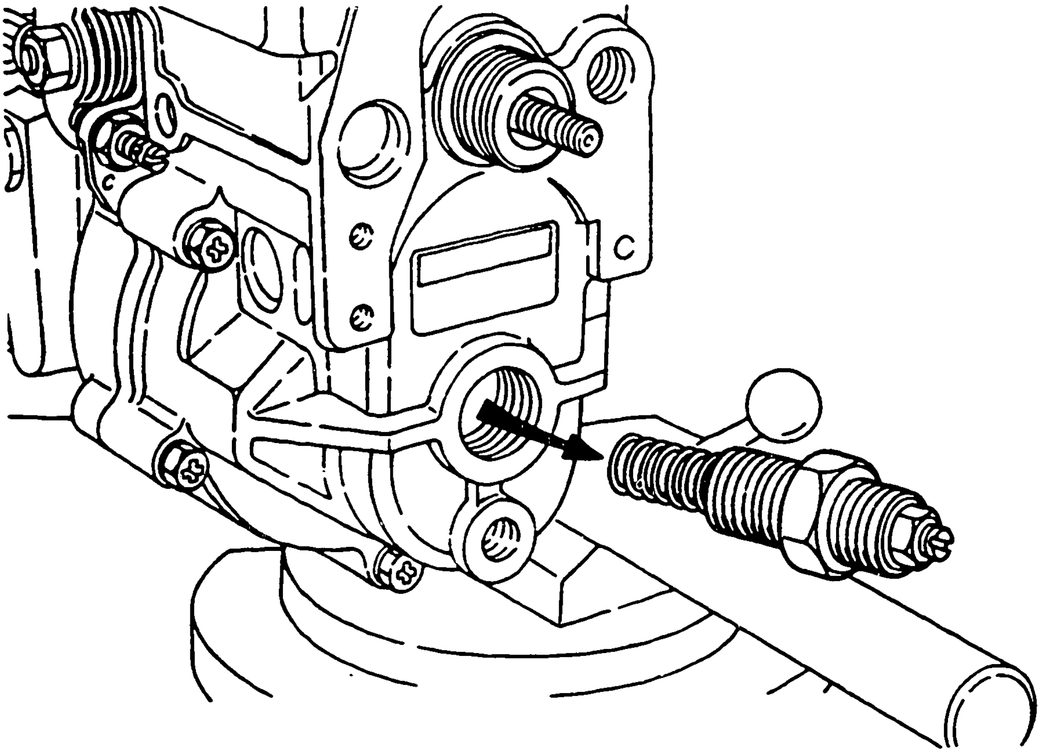


Fig. 34 Unscrewing idle-spring retainer

14. Unscrew cap nut (137) and detach lock nut (135).
    Then unscrew idle-spring retainer.

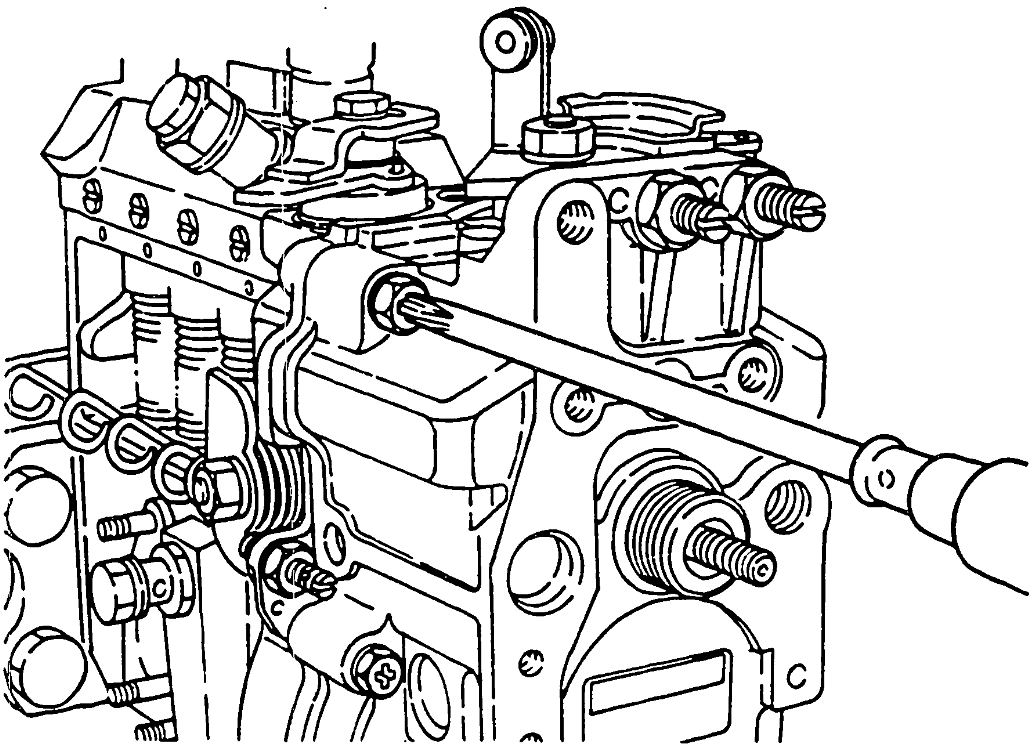


Fig. 35: Screwing out fastening screws of governor cover

15. Use screwdriver for recessed-head screws to screw out the seven fastening screws of the governor cover.
    Then remove governor cover from governor housing.

Note:
    Catch oil emerging from governor in oil pan.

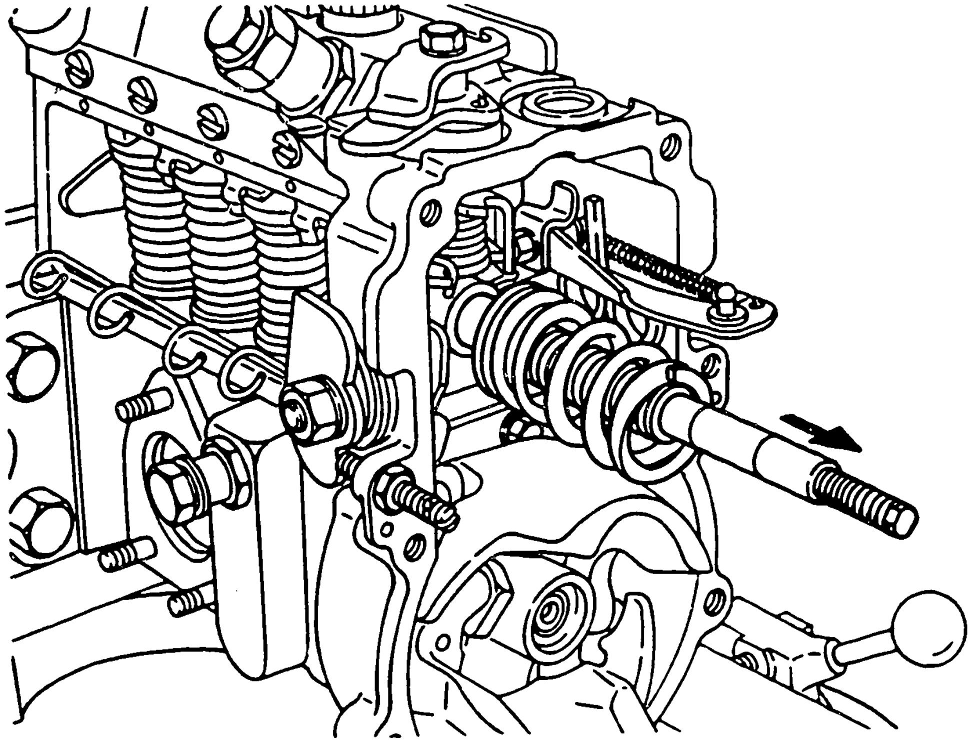


Fig. 36: Removing governor shaft

16. Remove governor shaft (140) together with governor springs (130 and 131) and spring seat (150)

17. Use pointed pliers to disengage starting spring (132) from connecting link (155).

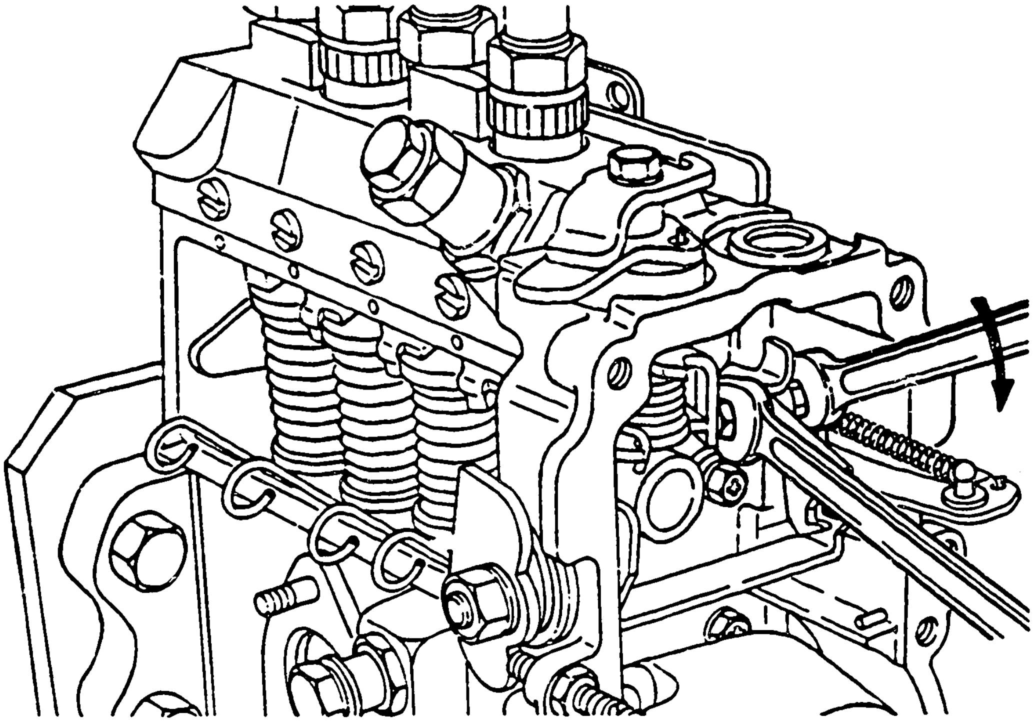


Fig. 37: Loosening screw and nut of connecting link

18. Use two wrenches (8 and 10 mm) to loosen screw (156) and nut (158) with which control rod and connecting link are held together.

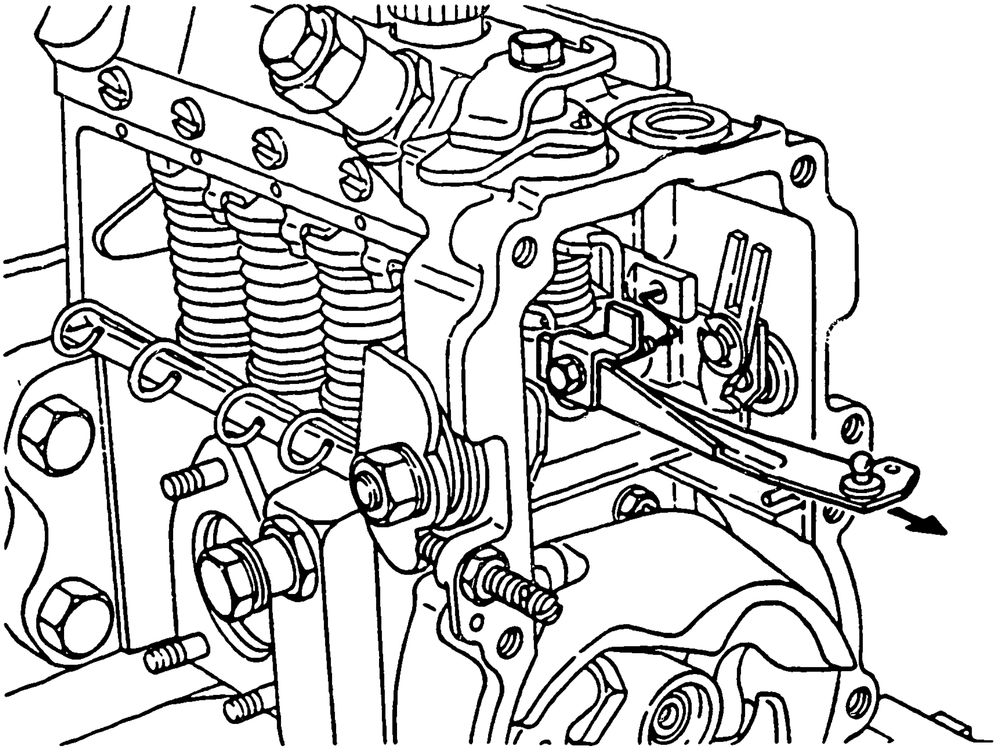


Fig. 38: Removing connecting link and screw

19. Remove connecting link (155) and screw (156) together.

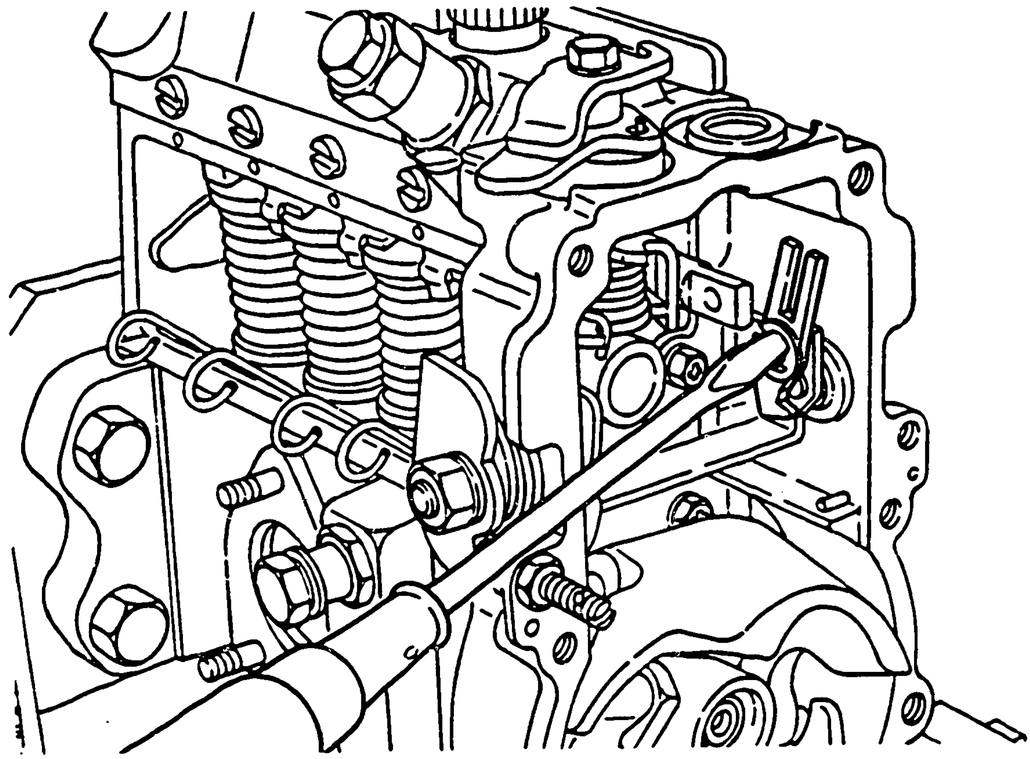


Fig. 39: Loosening lock washer

20. Unscrew nut (158) from sensing lever (9).

21. Detach lock washer (10) from pin of U-lever (17) and remove sensing lever (9).

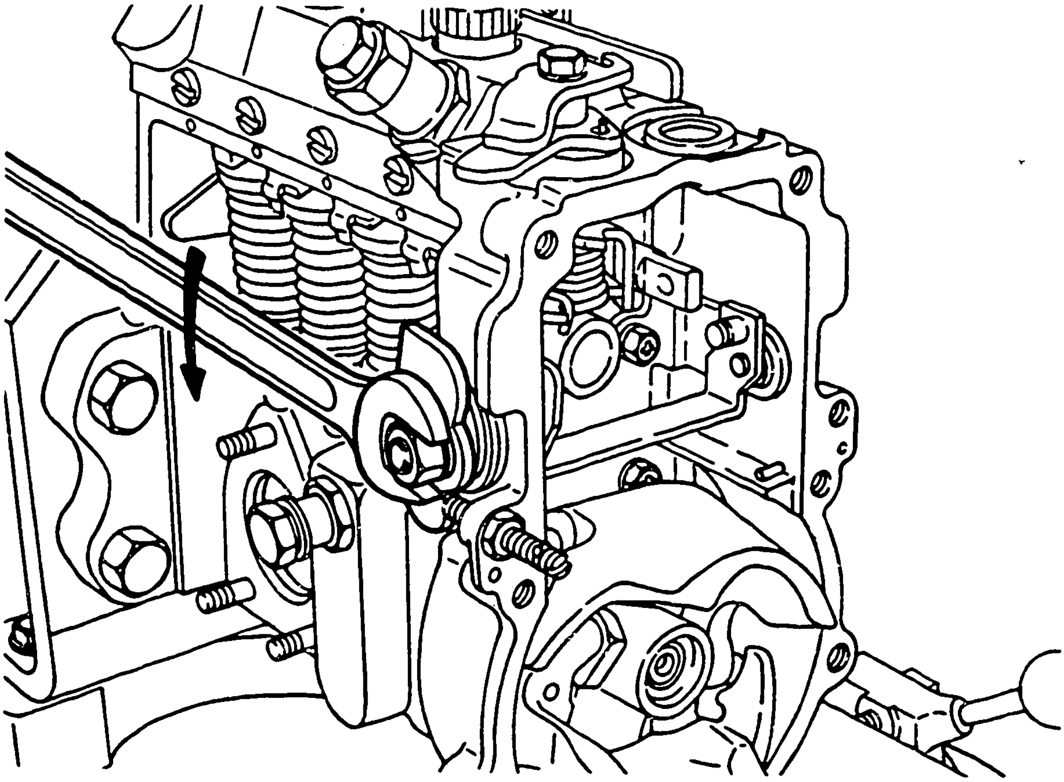


Fig. 40: Unscrewing nut of full-load adjustment lever

22. Unscrew nut (15); then remove full-load adjustment lever (13) and return spring (12) together.
Subsequently remove O-ring (7) and shim (11).

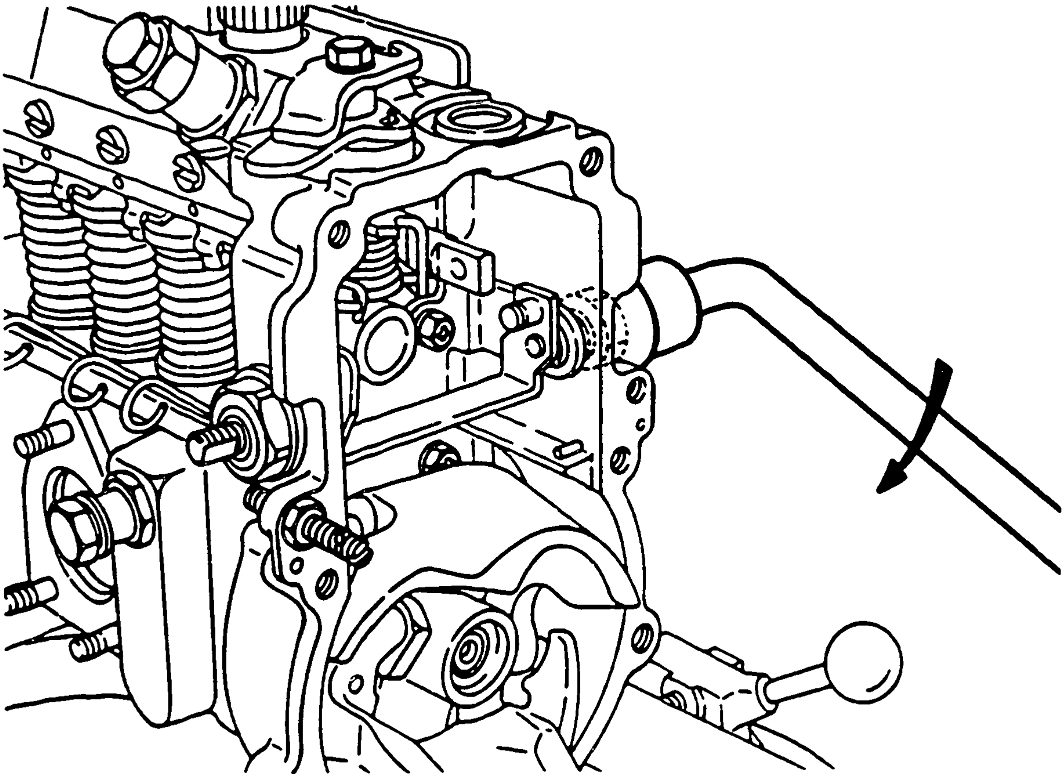


Fig. 41: Screwing out guide screw

23. Screw out guide screw (16).

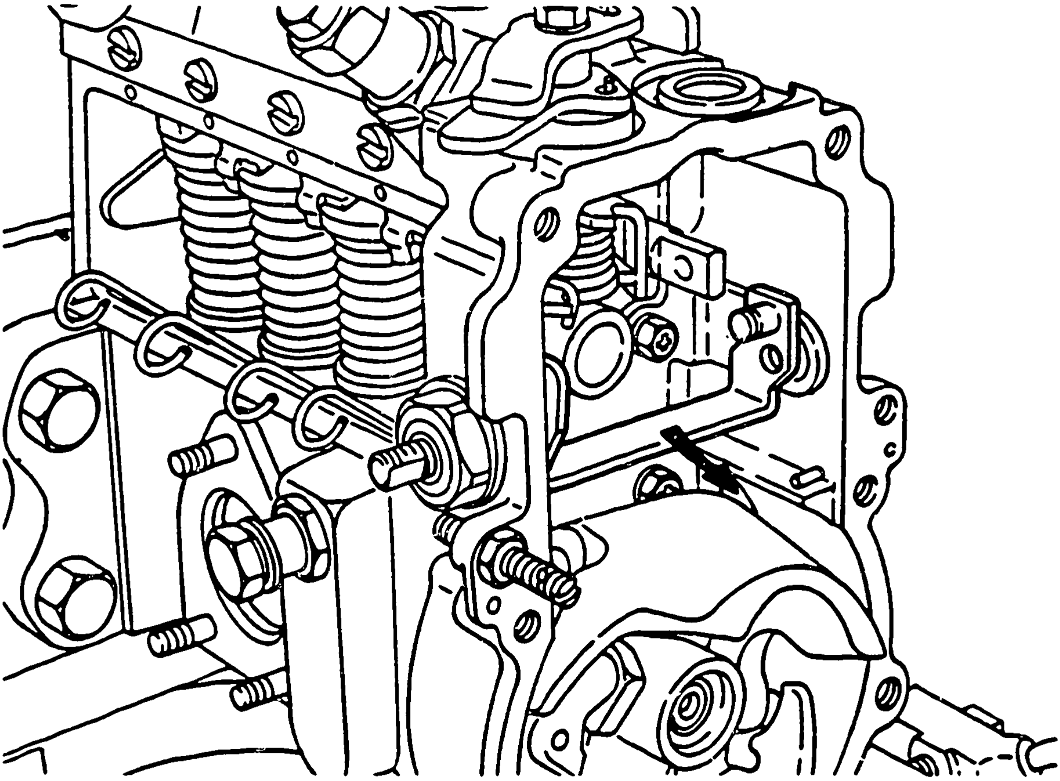


Fig. 42: Removing U-lever

24. Remove U-lever (17).

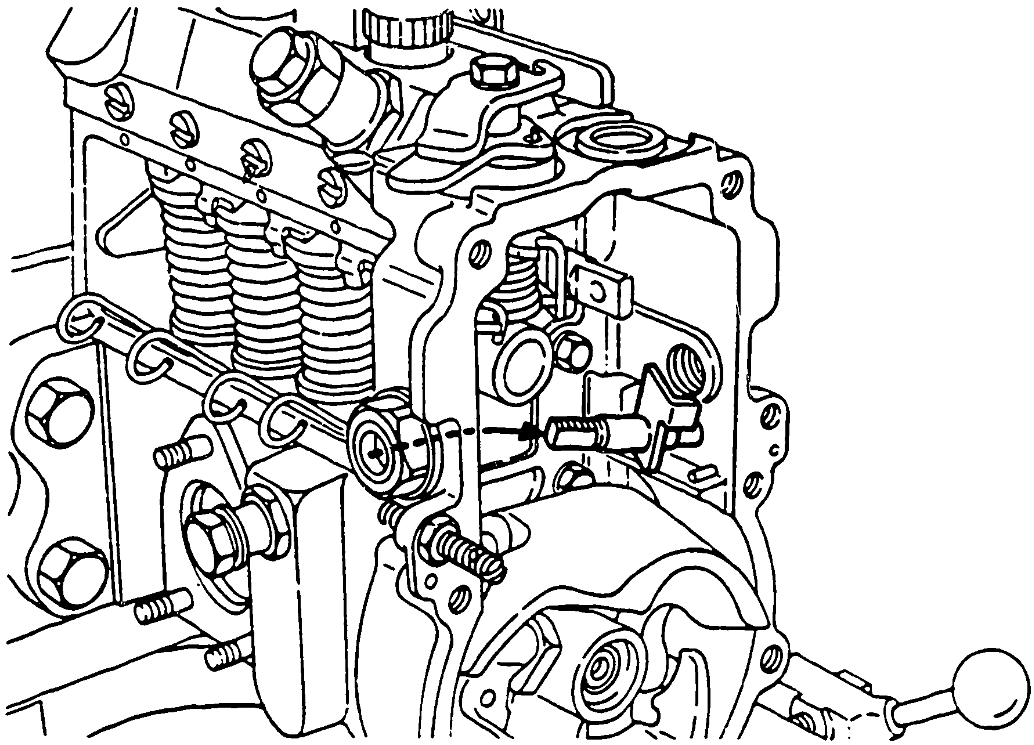


Fig. 43: Removing full-load-lever shaft

25. Remove full-load-lever shaft (8) and spring (18).

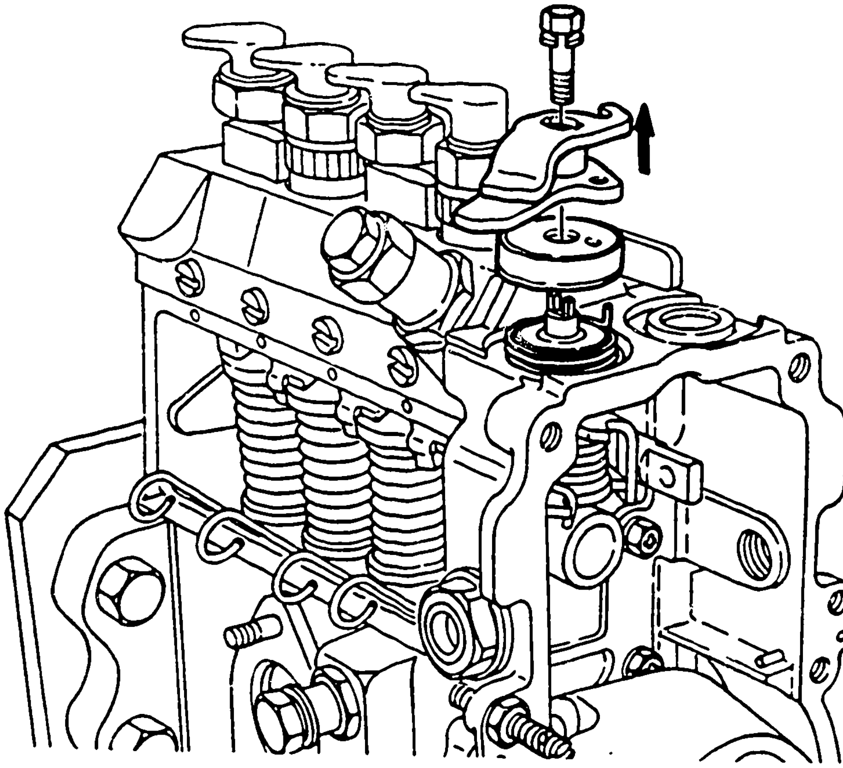


Fig. 44: Removing stop lever

26. Screw out screw (27); then remove stop lever (26), cap (25), spring (24), O-ring (22) and shim (23).

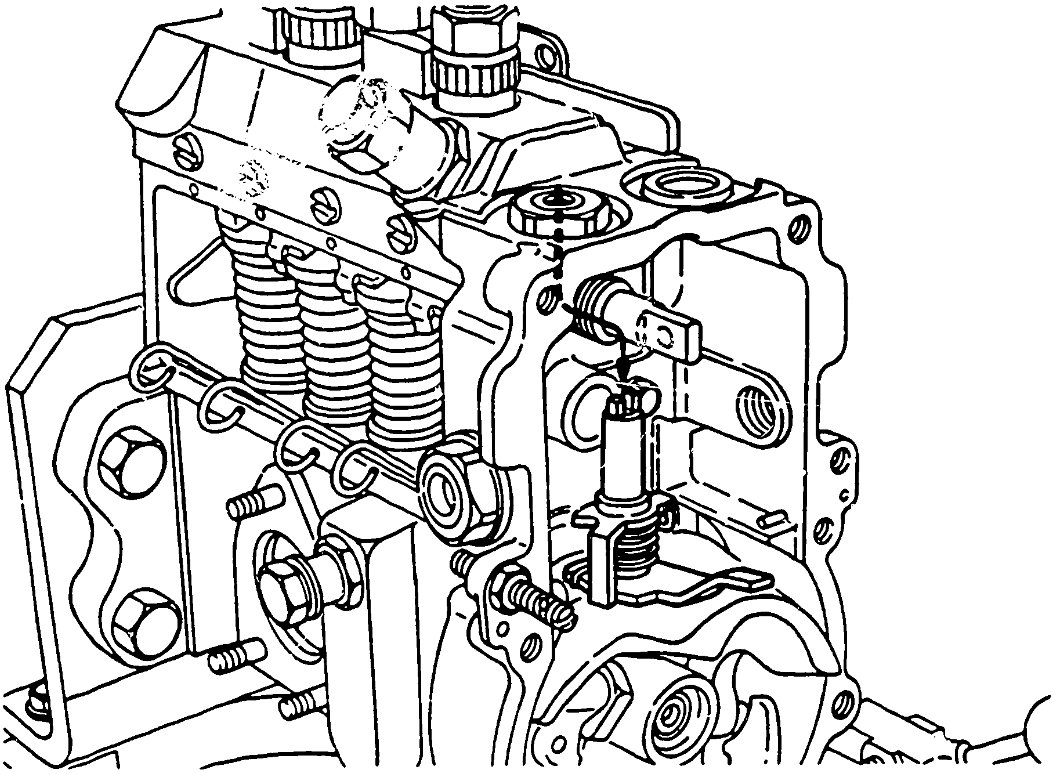


Fig. 45: Pulling out shaft

27. Pull out shaft (20).

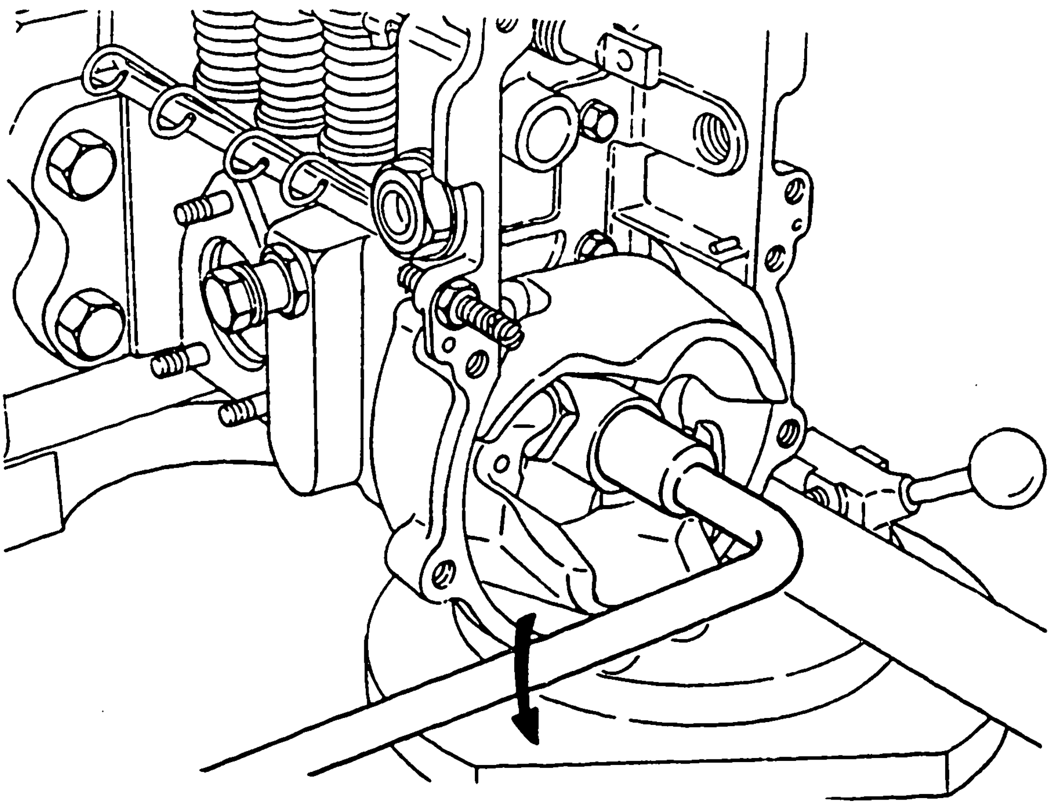


Fig. 46: Unscrewing lock nut

28. Use special wrench (KDEP 2906) to hold coupling (1 686 430 022), so that camshaft cannot turn as well. Then unscrew lock nut (103) of flyweight mount with socket wrench (KDEP 2626) and bell crank.

29. Use puller (KDEP 2918) to remove flyweight mount (100).

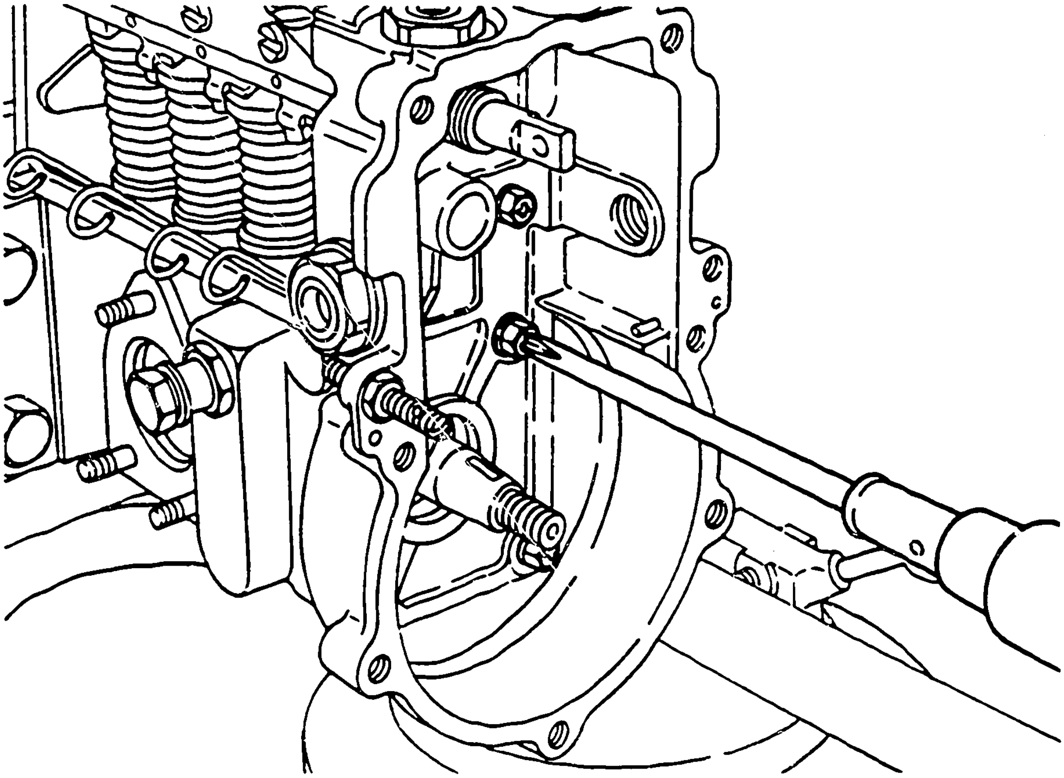


Fig. 47: Unscrewing screws

30. After disengaging starting spring (132) from rolled end of spring (4), use screw-driver for recessed-head screws and wrench (12 mm) to remove the seven screws (3 and 5) together with the rolled end of the spring.

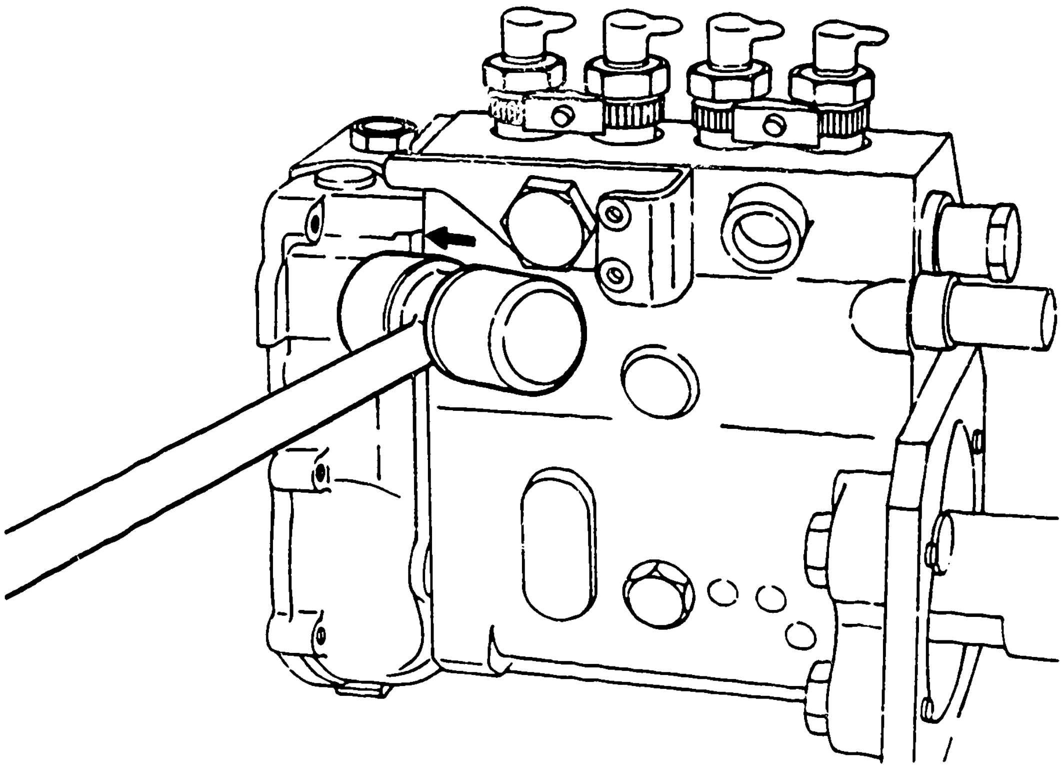


Fig. 48: Detaching governor housing

31. Detach governor housing from pump housing by tapping gently with plastic hammer.

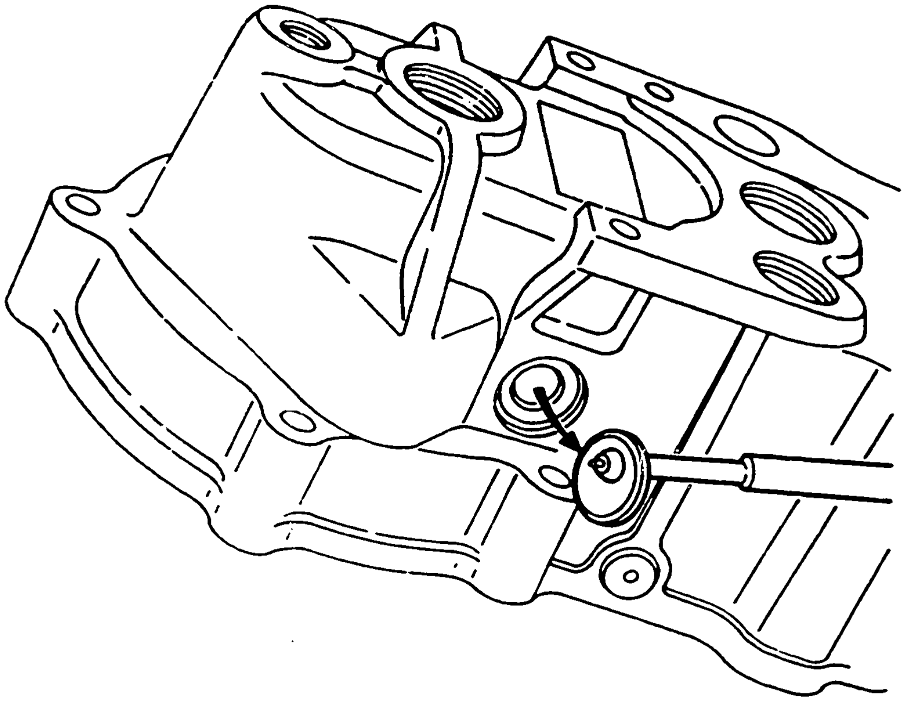


Fig. 49: Removing plug

The following operations refer to removal of the internals of the governor cover.

32. Use a punch to remove the two plugs (35/3) pressed into the governor cover (35).

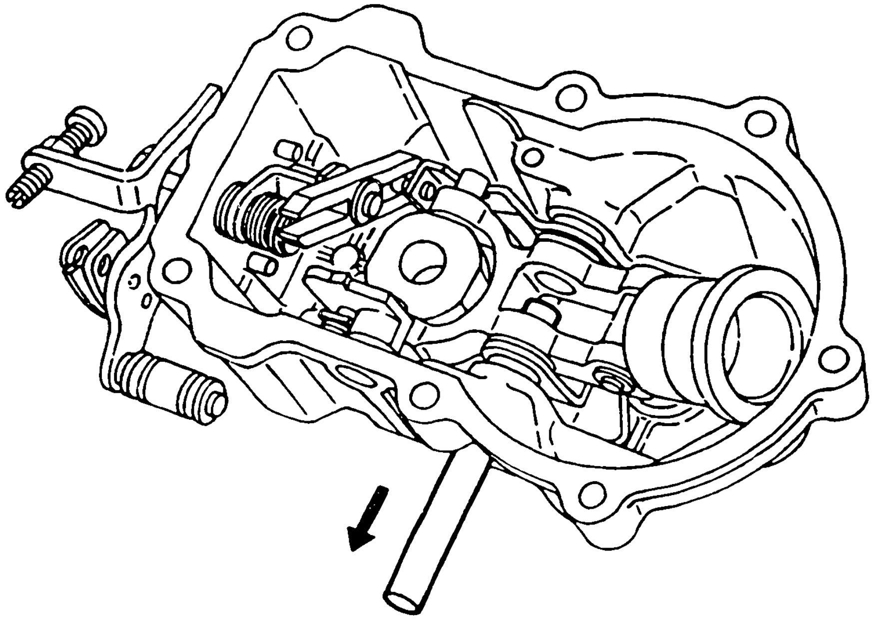


Fig. 50: Pulling out shaft

33. Pull out shaft (35/2).

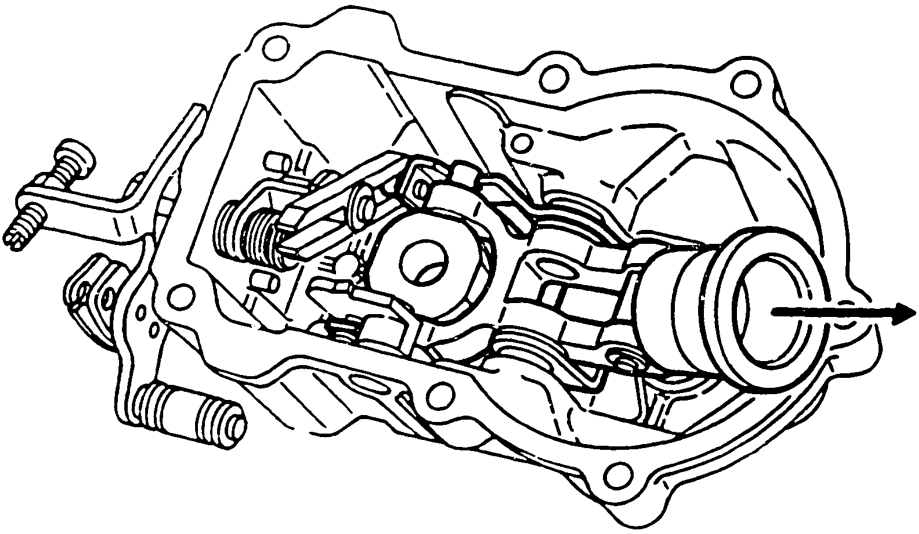


Fig. 51: Removing tensioning-lever assembly

34. Remove lock washer (303); then disconnect connecting rod (35/4/2) from torque-control edge cam (300).

35. Remove tensioning-lever assembly (35/4).

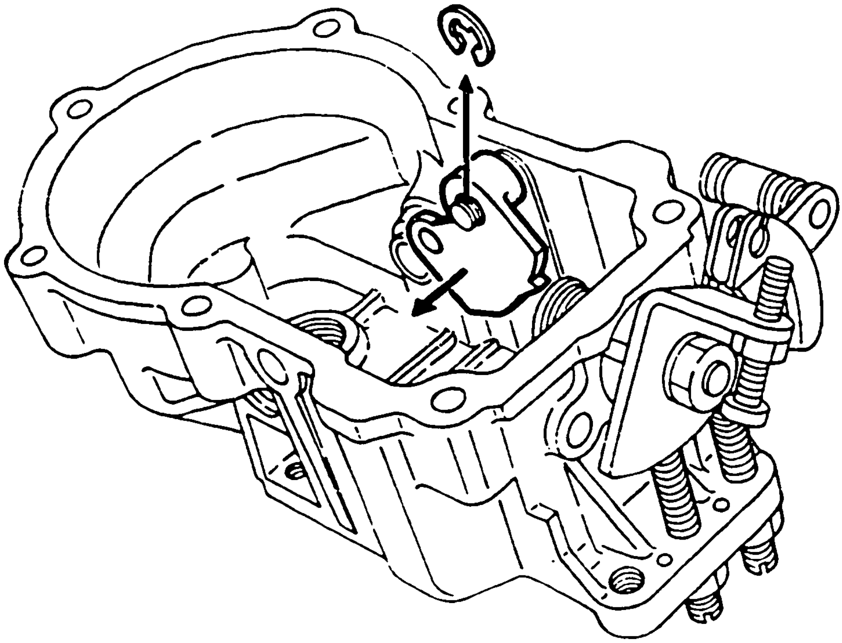


Fig. 52: Removing torque-control edge cam

36. Remove spring washer (301); then pull torque-control edge cam (300) off bearing pin pressed into governor cover.

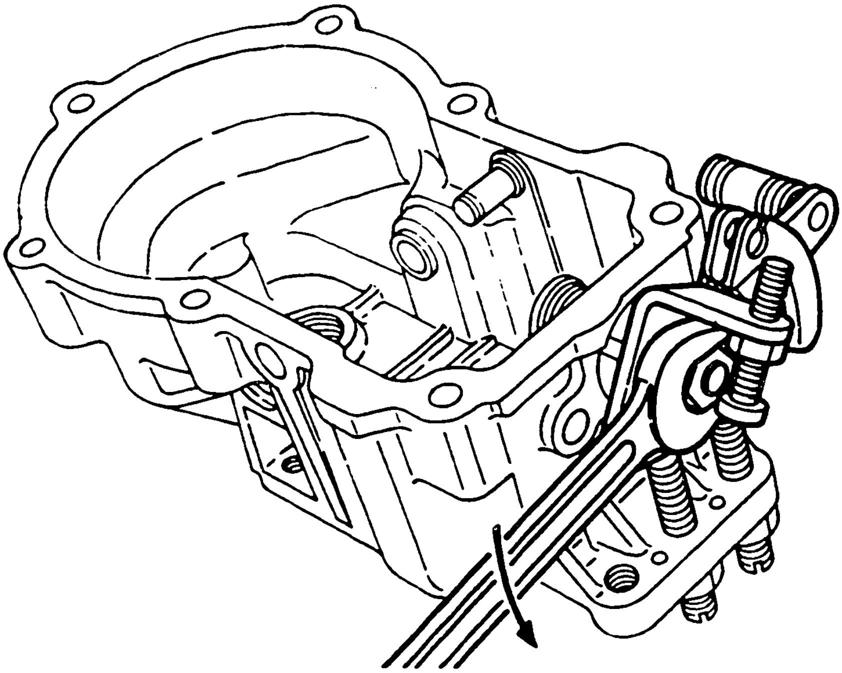


Fig. 53: Unscrewing control-lever nut

37. Unscrew nut (172); then remove speed-control lever (170).

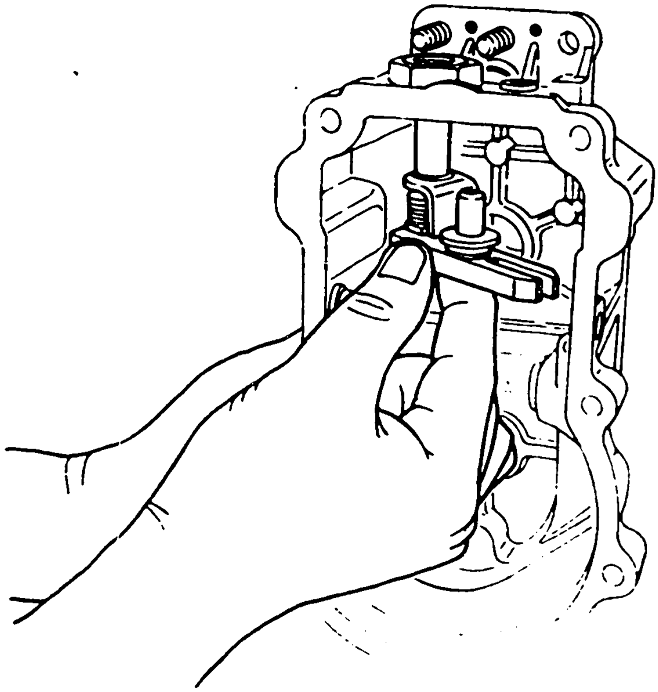


Fig. 54: Removing variable-fulcrum-lever assembly

38. Remove variable-fulcrum-lever assembly (160) from governor cover.

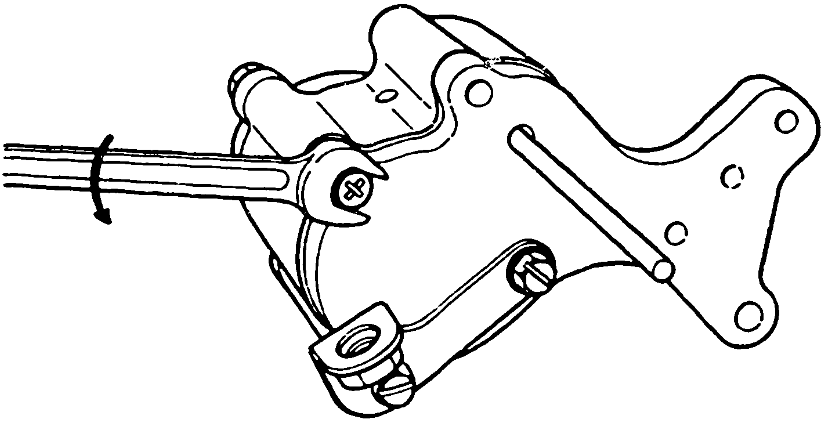


Fig. 55: Unscrewing screws

The operations that follow refer solely to disassembly of the manifold-pressure compensator.

39. Unscrew the three screws (320/24); then remove spacer plate (320/1 A) and thrust pin (320/6) together.

40. Clamp manifold-pressure compensator (320) in vice (make use of mounting jaws).

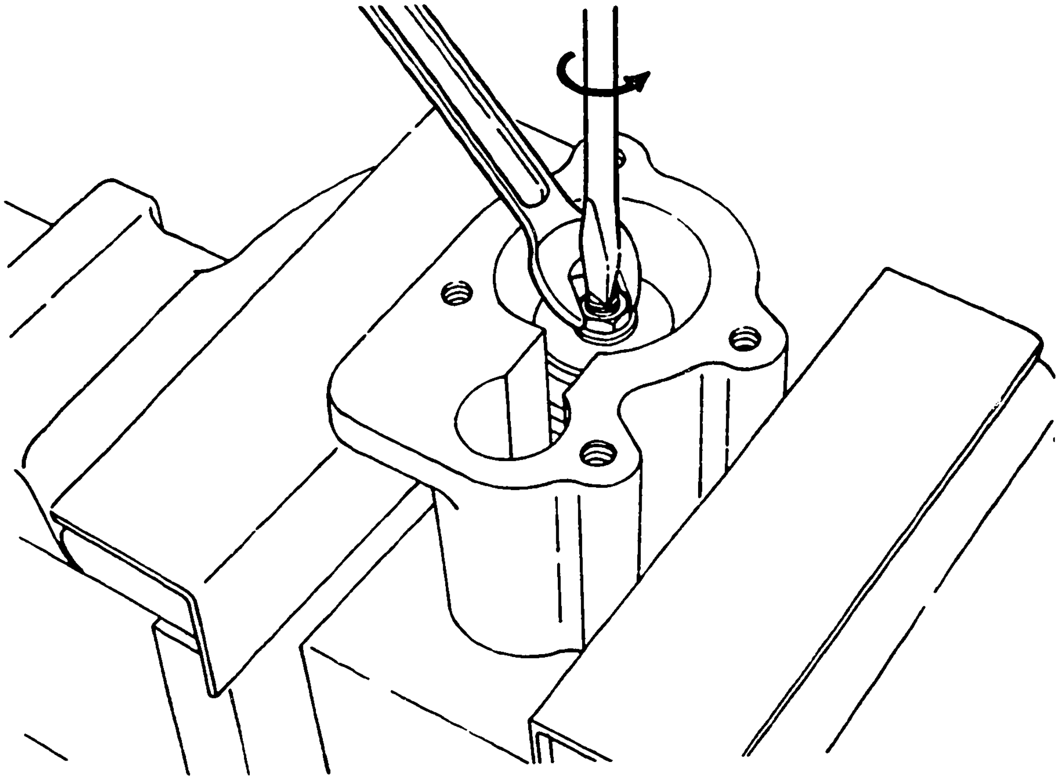


Fig. 56: Unscrewing lock nut

41. Hold shaft with screwdriver, unscrew lock nut (320/15) and remove washer (320/14).

42. Clamp manifold-pressure compensator in vice with upper side facing downwards.

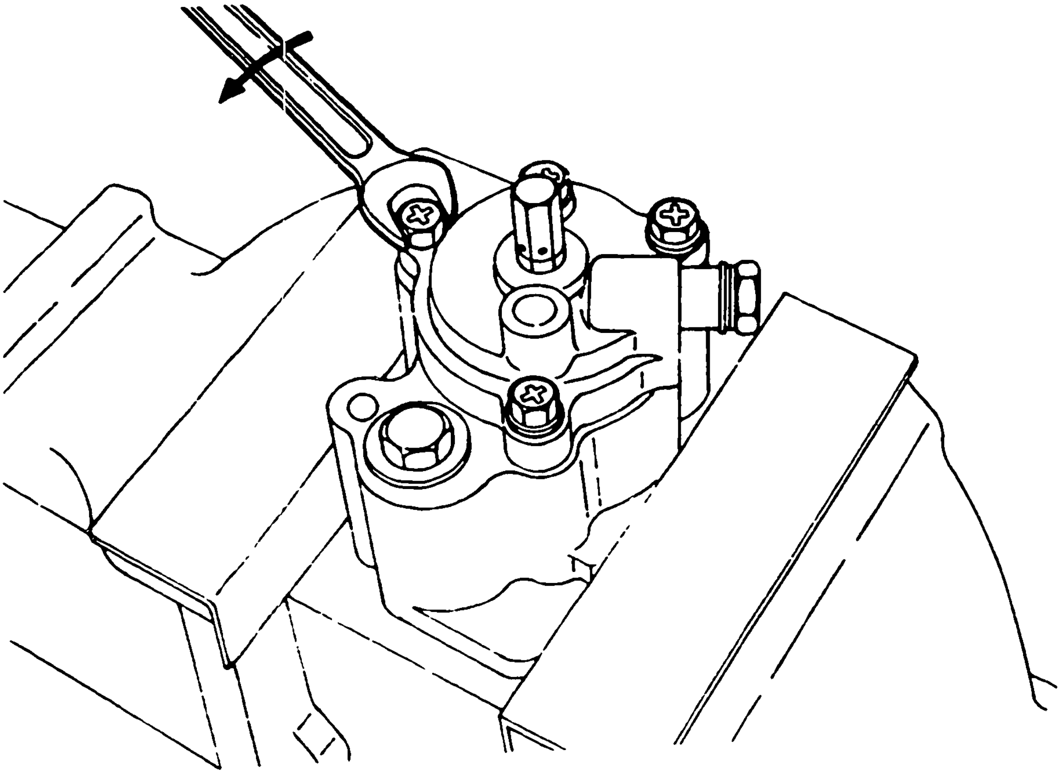


Fig. 57: Unscrewing screws

43. Unscrew the three screws (320/19) and remove cover (320/18).

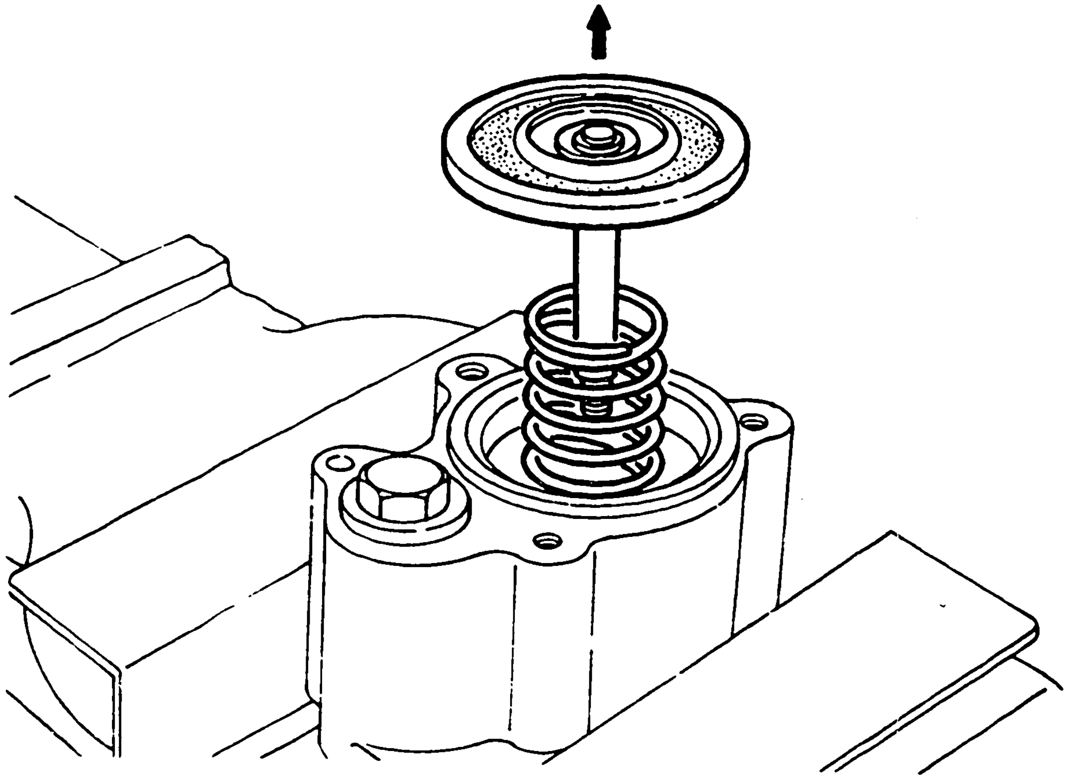


Fig. 58: Removing diaphragm

44. Remove diaphragm (320/11) and compression spring (320/16).

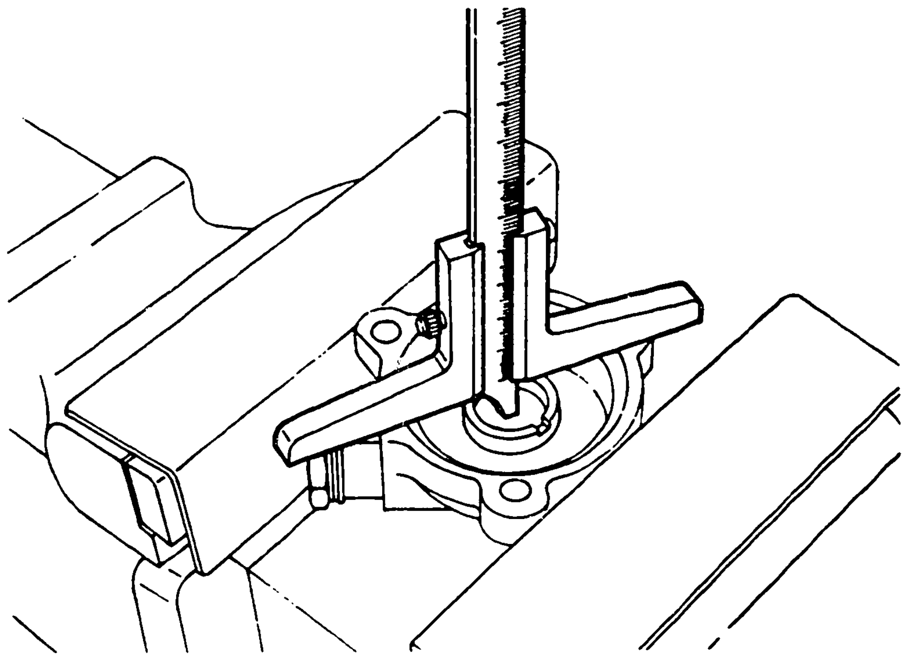


Fig. 59: Measuring position of screw

45. Before screwing out screw (320/62), measure distance between edge of cover (320/18) and base of screw (these components must be re-assembled in their original installation position).

46. Unscrew cap nut (320/61); then loosen nut (320/63) and screw out screw (320/62).

Disassembly of the type RLD-K mechanical governor equipped with manifold-pressure compensator is thus complete.

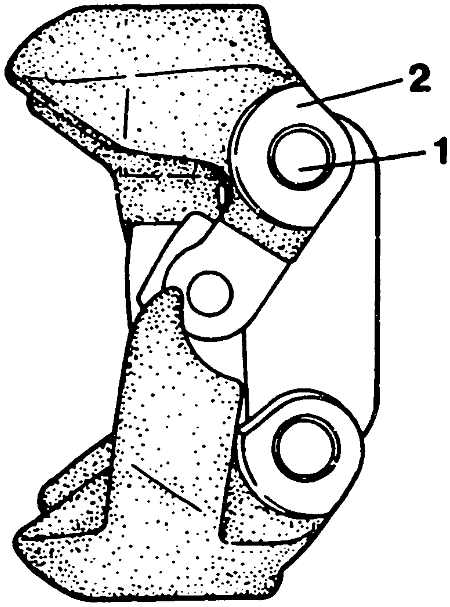


Fig. 60: Flyweight bearing pin

1 = Bearing pin
2 = Flyweight

TESTING

The following components are to be tested after disassembling the governor:

Flyweight assembly

1. Replace complete flyweight assembly if the clearance between flyweight bearing pin and flyweight (or flyweight bushing) is too large on account of wear.

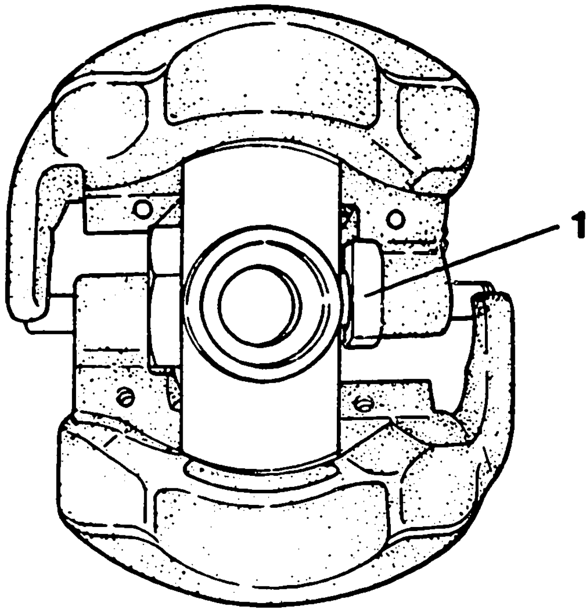


Fig. 61: Flyweight link

1 = Link

Flyweight bearing pin

2. If the sliding surface of the link exhibits extreme wear, and if the clearance between link and bearing pin is too large on account of wear in the link, the complete flyweight assembly is to be replaced.

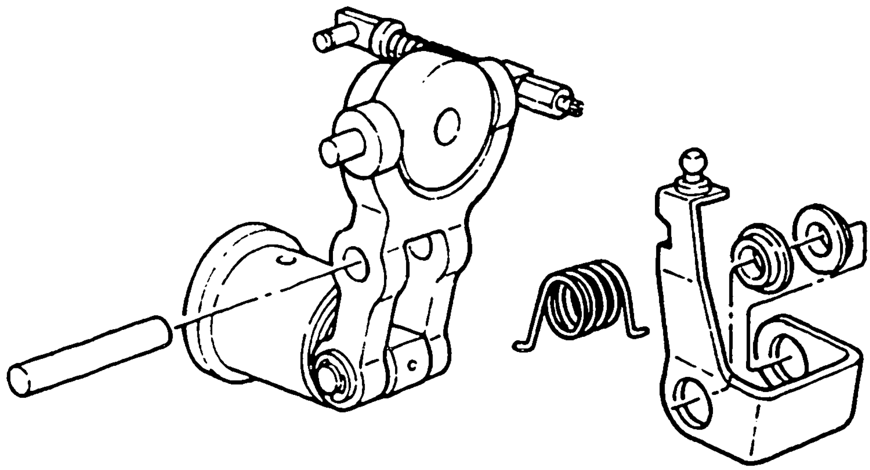


Fig. 62: Tensioning-lever assembly

Tensioning-lever assembly

Examine all parts of tensioning-lever assembly for wear. All moving parts, which do not move freely and evenly or which are damaged, are to be replaced.
Always check following surface areas:

1. Sliding surface between tensioning lever (35/4/1) and tensioning-lever shaft (35/2).

2. Sliding surface between tensioning-lever shaft and bushing (35/6).

3. Sliding surface between bearing pin (35/8) and sliding bolt.

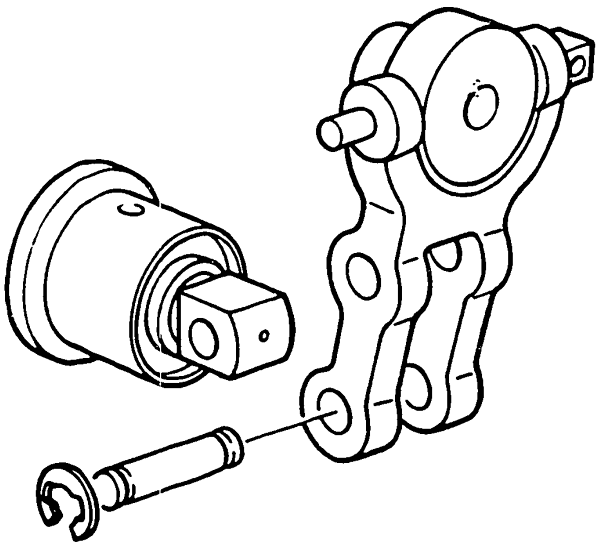


Fig. 63: Pulling out bearing pin

4. Sliding surface between bearing pin and tensioning lever.

5. Sliding surface between guide lever (35/5) and bushing.

6. In order to check them, all bearings must be disassembled using the following procedure:

   1) Remove spring washer (35/9) and pull out bearing pin (35/8).

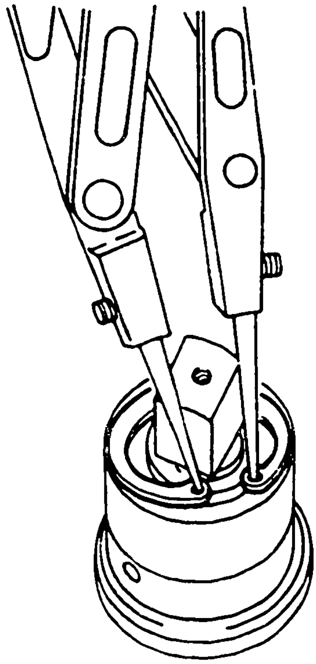


Fig. 64: Removing retaining ring

2) Use circlip pliers to remove retaining ring installed in sliding sleeve.

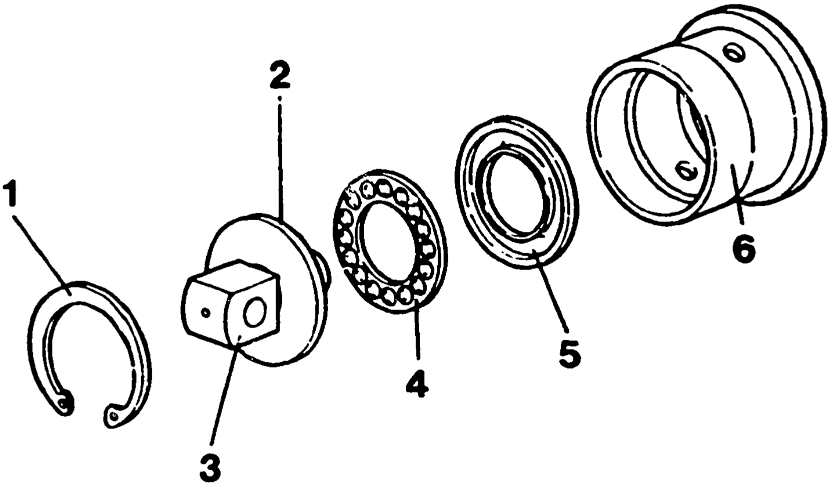


Fig. 65: Sliding sleeve, sliding bolt and bearing assembly

1 = Retaining ring
2 = Outer race
3 = Sliding bolt
4 = Ball cage
5 = Inner race
6 = Sliding sleeve

3) Remove sliding bolt and bearing, complete from sliding sleeve.

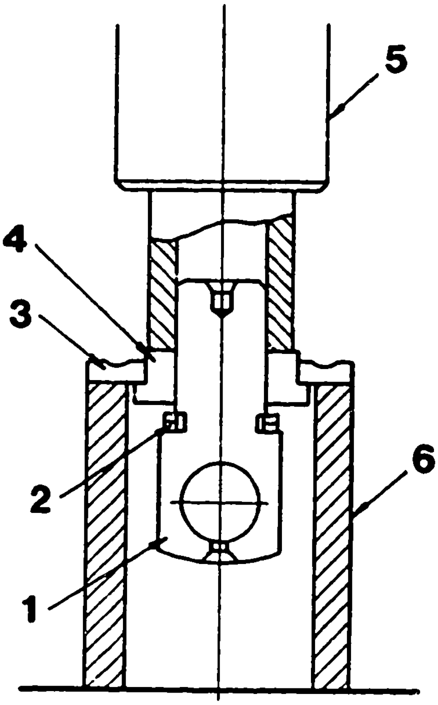


Fig. 66: Pressing off outer race

1 = Sliding bolt
2 = Shim
3 = Outer race
4 = Bushing
5 = Press
6 = Guide

4) Press off outer race of bearing beneath press as shown in Fig. 66.

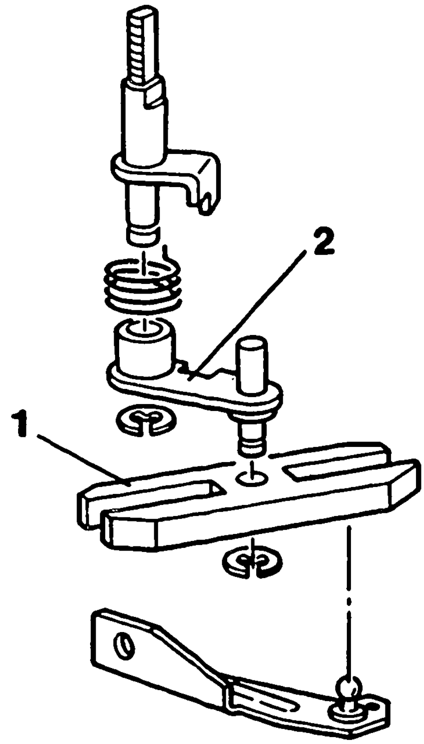


Fig. 67: Variable-fulcrum lever, support lever and associated components

1 = Variable-fulcrum lever
2 = Support lever

Variable-fulcrum lever, support lever, control-lever shaft and connecting link

Replace all heavily worn parts.
Carefully check guide slot of variable-fulcrum lever in particular.

Governor cover and governor housing

1. If the pressed-in bearing pins are bent either in the cover or the housing of the governor, the governor cover or governor housing is to be replaced.

2. If the bushing in which the tensioning-lever shaft is mounted is severely worn, replace governor cover.

3. If the lip of the radial seal ring (167) is damaged, replace radial seal ring.

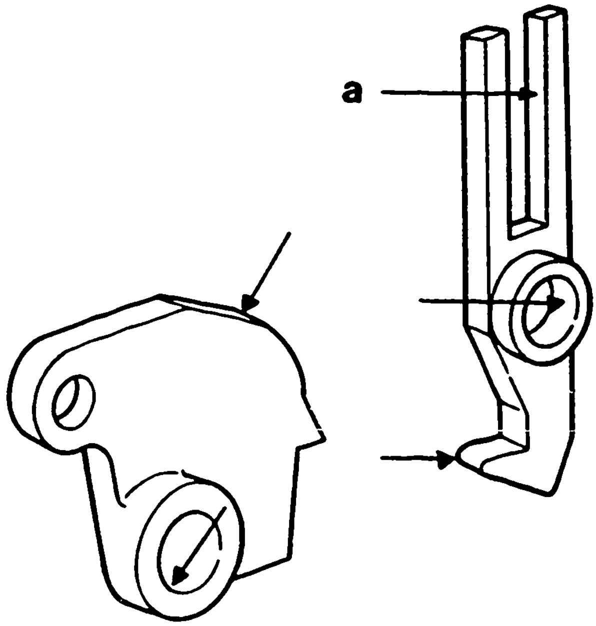


Fig. 68: Sensing lever and torque-control edge cam

a = Check for wear

Sensing lever and torque-control edge cam

If any sliding surface or contact surface on the sensing lever or on the torque-control edge cam is worn, replace both components.

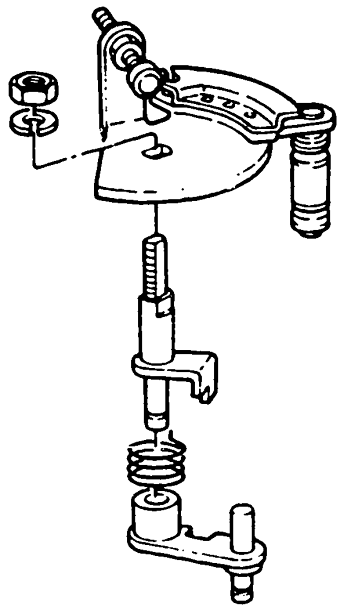


Fig. 69: Control-lever assembly

Control lever, control-lever shaft and support lever

If any sliding surface of the control lever, the control-lever shaft or the support lever is worn, these components must be replaced.

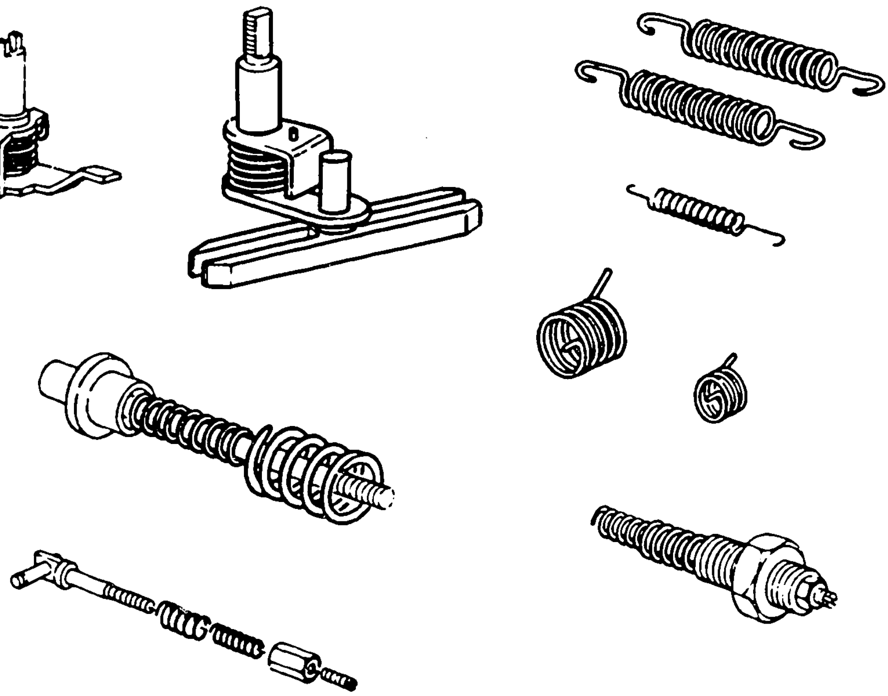


Fig. 70: Springs

Springs

All springs which exhibit any damage (bending, settling etc.), cracks or rusting are to be replaced.

ASSEMBLY

The type RLD-K governor is to be assembled in the reverse order of disassembly. Items which have to be given special attention during assembly are outlined in the following.

1. Seals, radial seal rings, O-rings, retaining rings and lock washers are not to be re-used following removal. New parts are to be employed on assembly.

2. Assemble and install shaft of full-load adjustment lever (8) with U-lever, sensing lever and connecting link in this order.

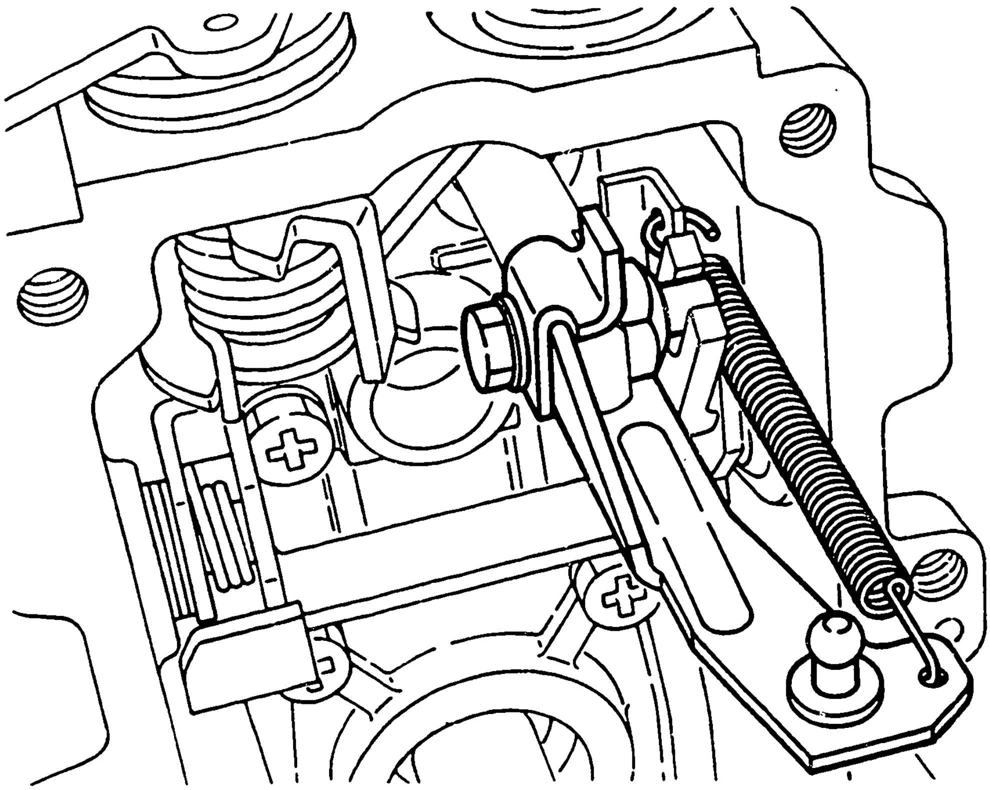


Fig. 71: Starting spring

3. The starting spring is to be suspended with its hook from the top in the hook hole in the connecting link (Fig. 71).

Note:

If the hook of the starting spring is positioned from underneath, it can get caught in a guide slot of the variable-fulcrum lever and impede its movement.

4. Tighten round nut (103) of flyweight mount to prescribed torque (5 - 6 kgm).

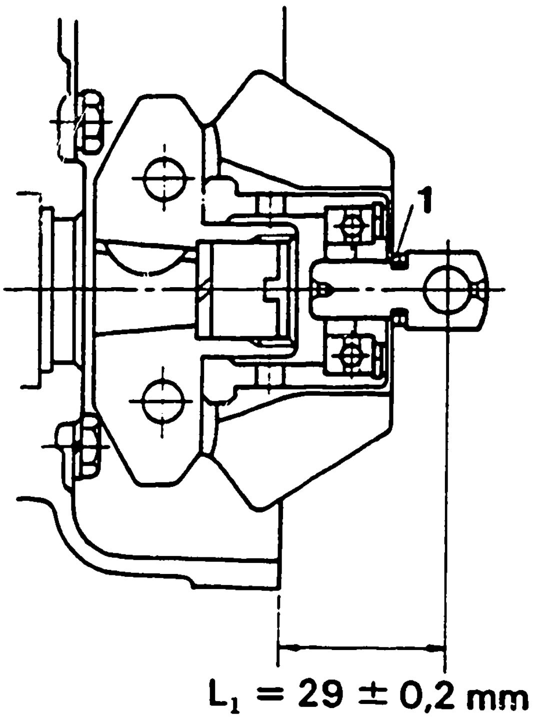


Fig. 72: Installation position of sliding bolt

1 = Shim

5. Installation of sliding bolt

Once the sliding bolt has been installed in the sliding sleeve, insert sleeve as far as it will go into flyweight mount; keep sleeve pressed against flyweight mount, such that flyweight travel is maintained on zero. In this condition, check whether distance between end face of governor housing and center of bearing-pin hole in sliding bolt is between 28.8 and 29.2 mm (Fig. 72).

Installation of sliding bolt (continued)

If the spacing is not as outlined on the previous page, the corresponding shim must be fitted.

Shims

* Part no.	Thickness (mm)
029311-6010	0.2
029311-0180	0.3
029311-0190	0.4
029311-0210	1.0

*) Bosch No., refer to cross-reference DKKC - Bosch, microcard HB 30, HB 31.

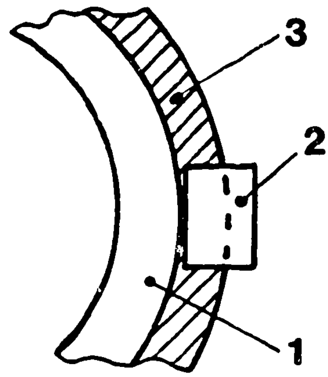


Fig. 73: Stepped wear on sliding sleeve

1 = Sliding surface of sliding sleeve
2 = Sliding surface of link
3 = Wear

Note:

If the distance is greater than 29.2 mm, the sliding surface of the sliding sleeve, which makes contact with the link, has become subject to stepped wear. The consequence of such wear is that the link does not make proper contact with the sliding surface of the sleeve if the flyweights are completely pivoted out (Fig. 73).
If the distance is less than 28.8 mm, the flyweights cannot fully pivot out (results in inadequate flyweight stroke).

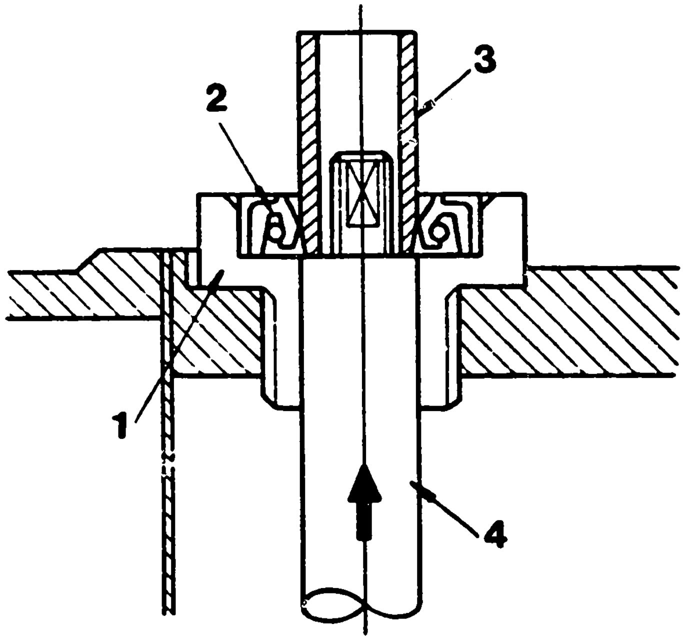


Fig. 74: Installation of control-lever shaft

1 = Bushing
2 = Radial seal ring
3 = Guide tube
4 = Control-lever shaft

6. When installing the control-lever shaft (160/6) in the bushing of the governor cover, use a guide tube so as not to damage the radial seal ring.

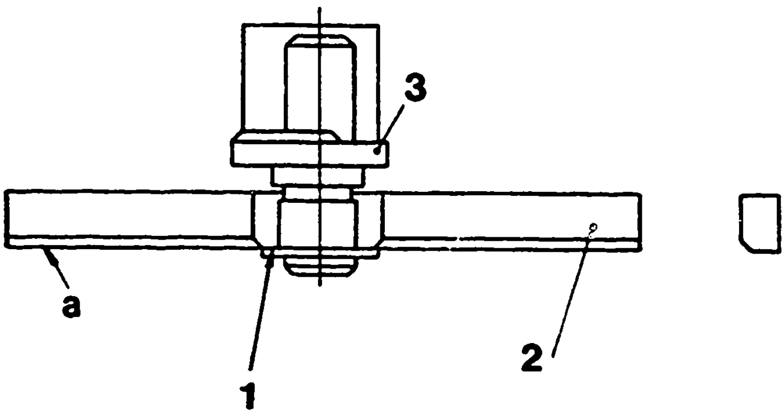


Fig. 75: Variable-fulcrum lever and support lever

1 = Punch mark
2 = Variable-fulcrum lever
3 = Support lever
a = Side with chamfered guide slot

7. Assemble variable-fulcrum lever with support lever. In doing so, the chamfered side of the guide slot of the variable-fulcrum lever must face downwards.

Note:

There is a punch mark ⊙ on the chamfered side of the guide slot.

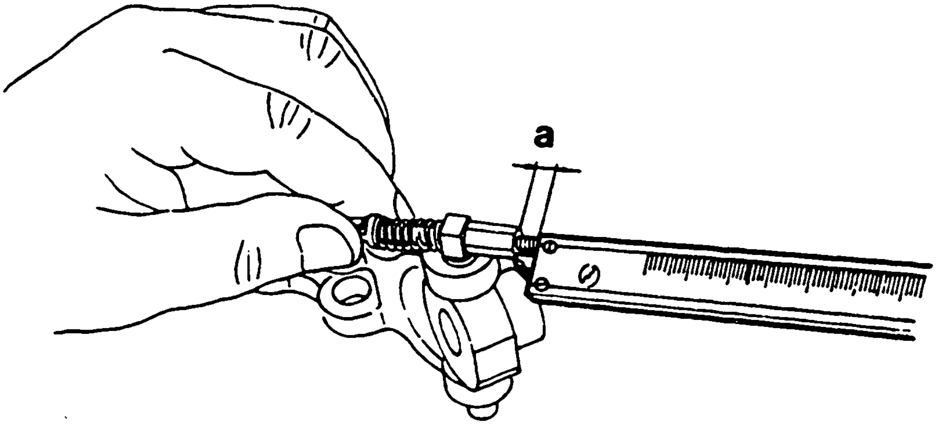


Fig. 76: Measuring distance between end of securing screw and end face of adjusting nut

a = 3 - 6 mm

8. Set installation position of torque-control edge cam with adjusting nut (35/4/3) and securing screw (35/4/4) such that there is a distance of 3 - 6 mm between the end of the adjusting screw and the end face of the adjusting nut. Then lock adjusting nut with securing screw.

Note:

If the adjusting nut is not locked in this operation, both the securing screw and the adjusting nut may come loose when adjusting the fuel-injection pump.

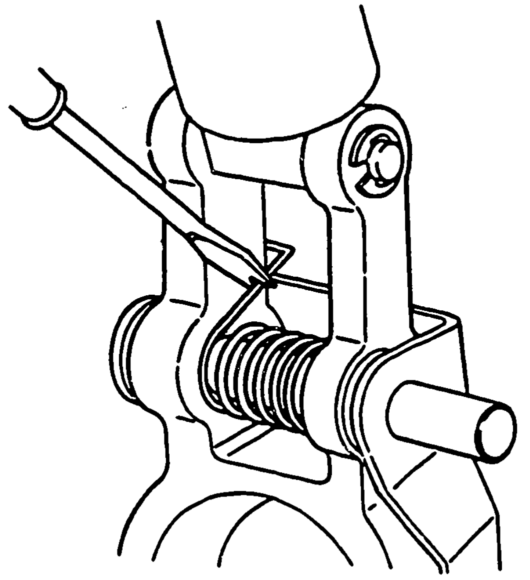


Fig. 77: Positioning return spring

9. In order to facilitate positioning of the return spring (35/7), it is advisable to use a screwdriver with a notch in its blade as shown in Fig. 77.

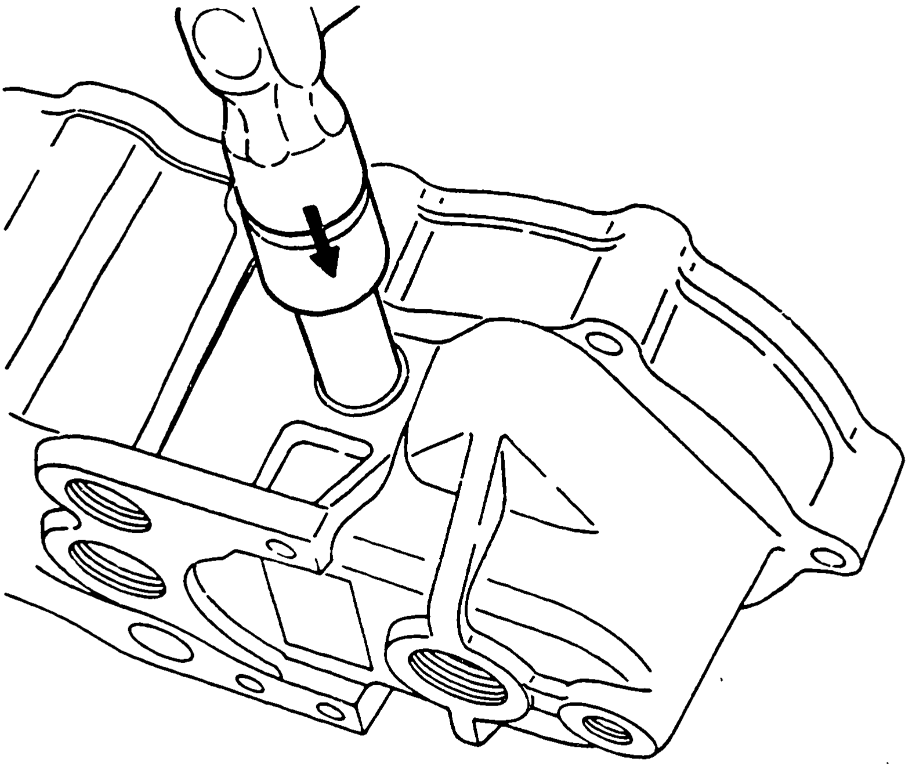


Fig. 78: Pressing in tensioning-lever-shaft plug

10. The governor cover must be fitted with new plugs (34/2) which are to be pressed into the cover; these plugs secure both ends of the tensioning-lever shaft. On pressing them in, flare the plugs such that they sit tightly (Fig. 78).

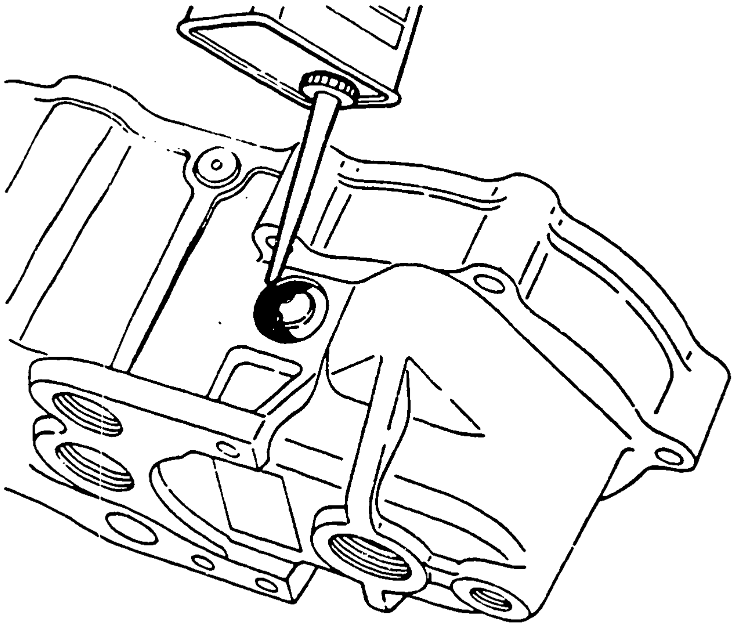


Fig. 79: Applying adhesive to outside of plugs

11. Seal outside of each plug with liquid adhesive, so as to ensure that no lubricating oil emerges.

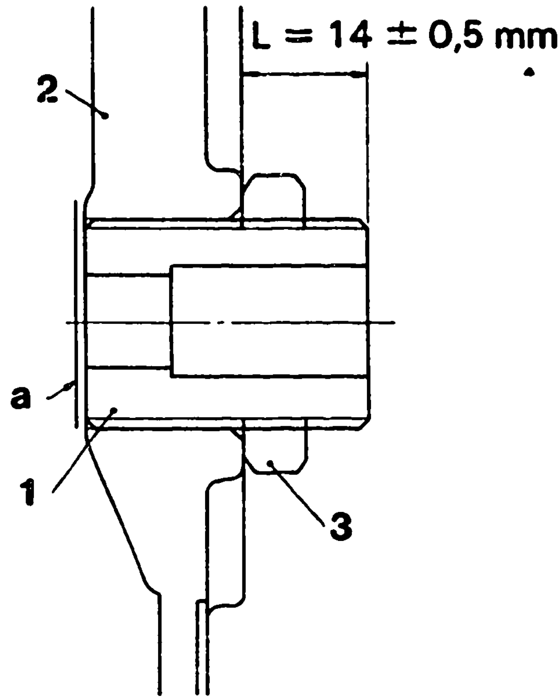


Fig. 80 Installing guide screw

1 = Guide screw
2 = Governor cover
3 = Nut

a = flush

12. Lock guide screw (141) with nut (147). In doing so, a spacing of 13.5 - 14.5 mm is to be set between the end of the guide screw and the outside of the governor cover. In this case, the opposite end of the screw is more or less flush with the inner surface of the governor cover.

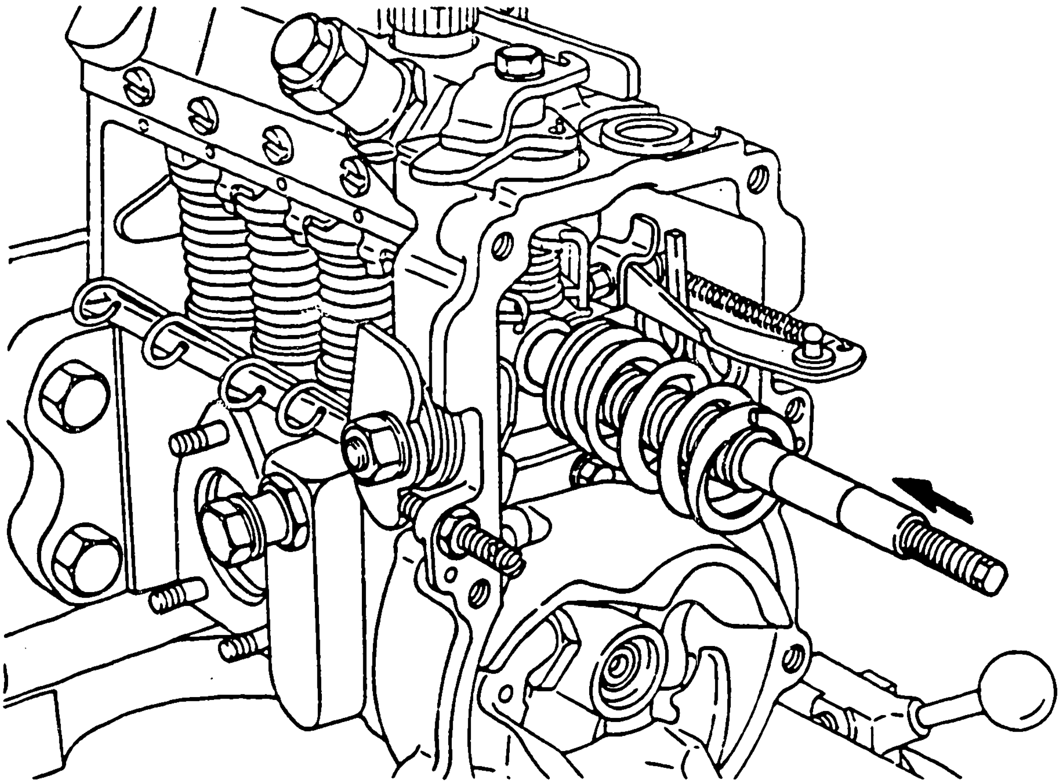
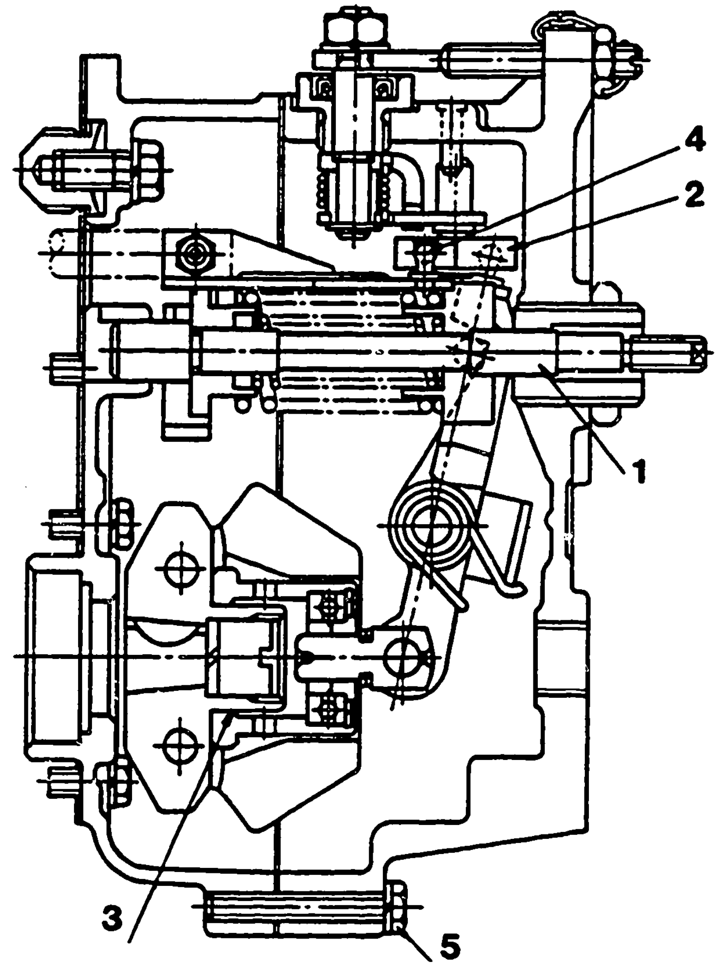


Fig. 81 Installing governor shaft

13. After providing governor shaft with spring seat (150) and governor springs (130 and 131), insert it into governor housing.

Note:

The spring seat must be installed on the governor shaft with the stepped side facing the governor springs (the governor-housing side is flat).



1 = Step 1)
2 = Step 2)
3 = Step 3)
4 = Step 4)
5 = Step 5)

Fig. 82: Assembly of governor cover

Prescribed tightening torque: 0.7 - 0.9 kgm

14. Sequence of governor-cover assembly.

1) First position spring seat of tensioning lever with step in spring seat facing governor springs, then insert governor shaft into center bore in spring seat.

2) Insert spherical pin of guide lever into guide slot in variable-fulcrum lever.

3) Insert sliding sleeve into flyweight mount.

4) Press control rod towards governor and hold. As next step, insert spherical pin of connecting link into guide slot in variable-fulcrum lever.

5) Finally tighten the seven screws diagonally using the same tightening torque for each screw.

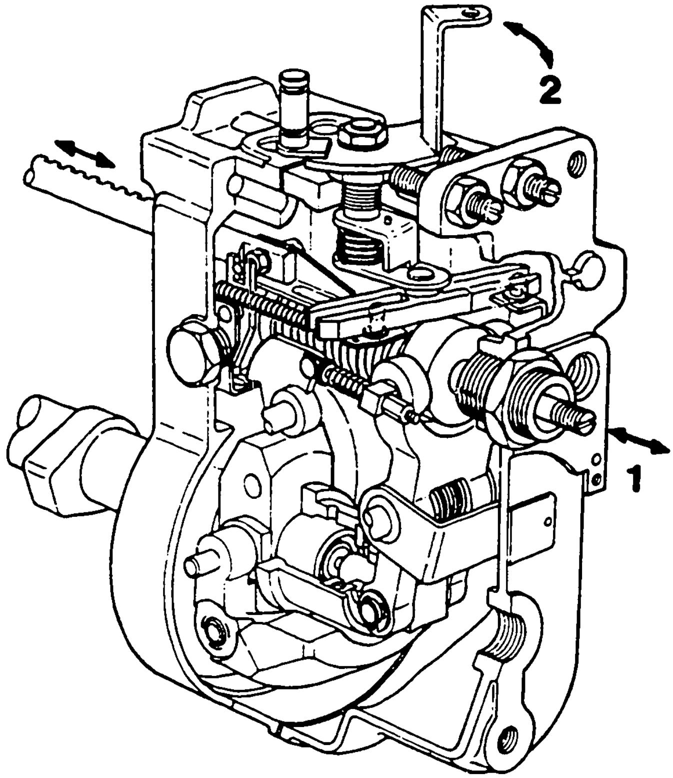


Fig. 83: Checking and confirming slip resistance of governor shaft and control rod

1 = Step 1) 2 = Step 2)

15. Check the following after assembling the governor cover (Fig. 83):

    1) Make sure that governor shaft can be freely moved by hand.

Note:
If the governor shaft does not move freely, the 7 screws of the governor cover are to be loosened, so as to enable the governor cover to be moved back and forth until the center of the governor shaft is in alignment with the center of the guide-screw hole. Then tighten screws again.

Checking and confirmation of slip resistance of governor shaft and control rod (continued)

2) Check whether the control rod can move freely and evenly when the control lever is operated.

Note:

If the control rod does not move freely, remove governor cover and establish cause.

The following adjustments must be made once the type RLD (K) governor has been assembled:

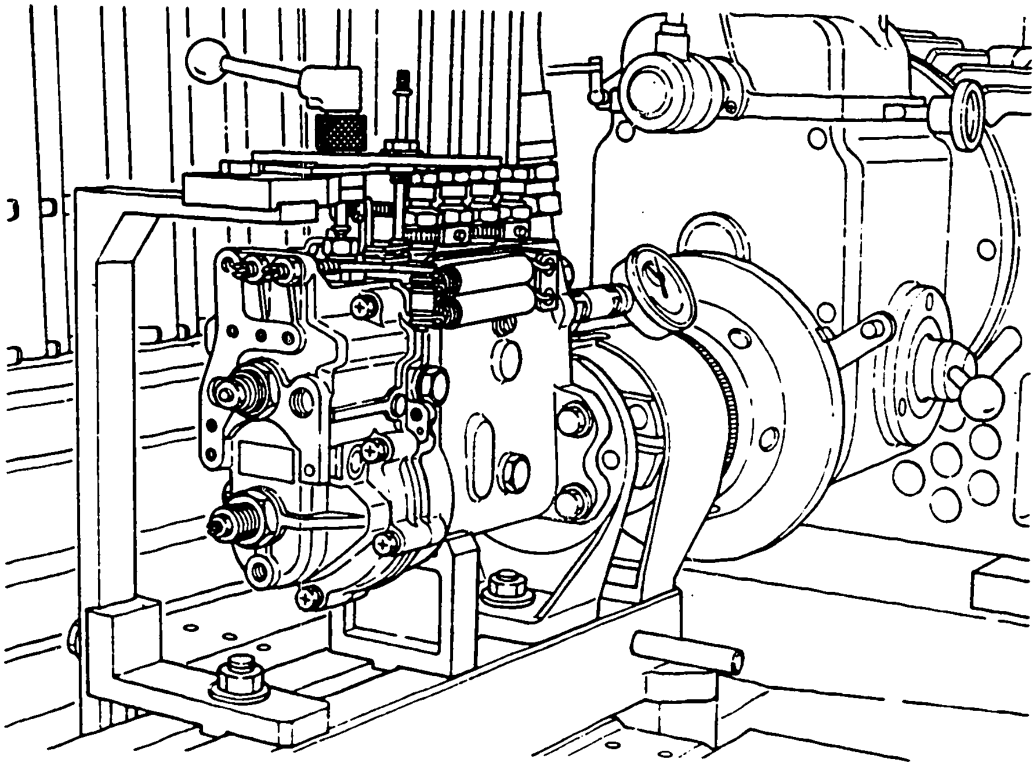


Fig. 84: Clamping fuel-injection pump in position

Preparation

Attention is to be paid to the following instructions as regards preparation for adjustment:

1. Clamp fuel-injection pump in position on injection-pump test bench and fill both governor housing and cam space with lubricating oil.

2. Remove idle-spring assembly, manifold-pressure compensator and lock nut of governor shaft.

3. Loosen maximum-speed adjusting screw, idle-speed adjusting screw and full-load adjusting screw.

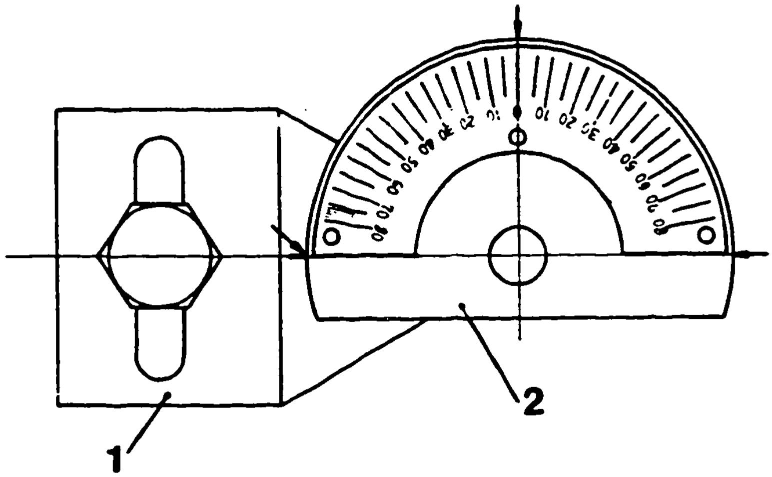


Fig. 85: Attaching graduated dial

1 = Holder
2 = Graduated dial

4. Attach setting device (KDDC 0018)

   1) Align mark on holder with mark on graduated dial and then tighten lock nut.

Note:
The graduated dial has three alignment marks; use can be made of any suitable one.

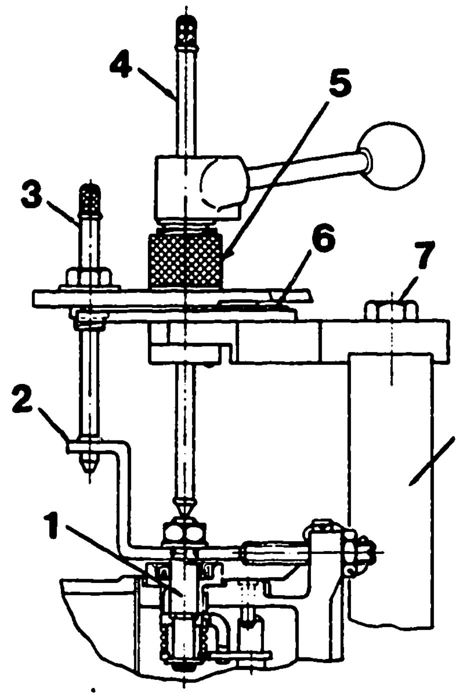


Fig. 86: Attachment of setting device

1 = Control-lever shaft
2 = Control lever
3 = Pin B
4 = Pin A
5 = Lock nut
6 = Graduated dial
7 = Adjusting screw
8 = Stand

2) Move holder of setting device such that pin A is over centering hole of control-lever shaft; then screw on holder. Insert pin B into mounting hole in control lever.

Attachment of setting device (continued)

3) Loosen handle to see whether it moves freely when the control lever is operated.

5. The adjusting nut of the torque-control edge cam must be secured with the securing screw as shown in Fig. 76.

Setting zero position of control rod

1. Attach measuring device for control-rod travel (1 688 130 130) to end of control rod.

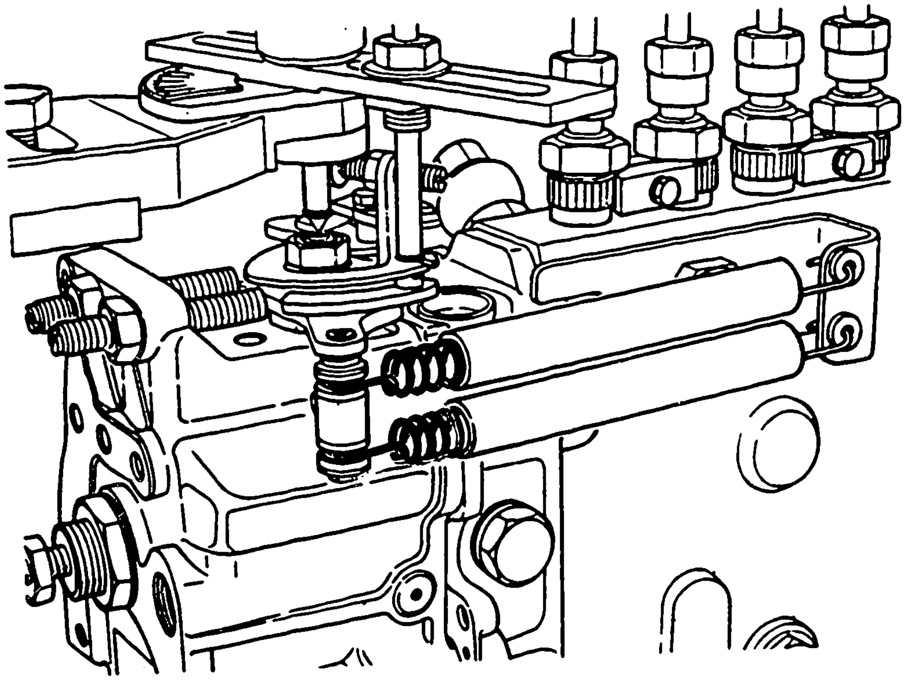


Fig. 87:

2. Block control lever in idle position (Fig. 87).

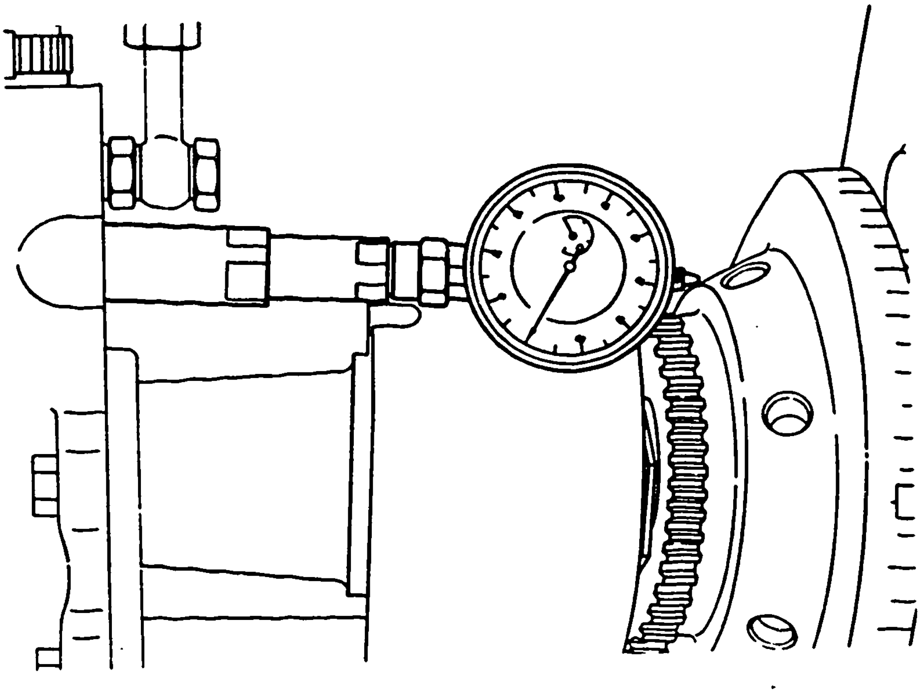


Fig. 88:

3. Press governor shaft inwards until it makes contact with wall of pump housing. Maintain pump speed between 1000 and 1200 min^{-1} and set control rod to position at which dial gauge indicates zero.

Note:

The control rod of a fuel-injection pump with type RLD-K governor can only be set to zero if the pump is operated at 1000 min^{-1}. If the control rod is pressed into the zero-delivery position with the fuel-injection pump running at less than 1000 min^{-1}, the control rod may be damaged.

Precautionary measures during adjustment

1. Blocking of control rod

   The control rod must be blocked when performing this operation. The fuel-injection pump is normally set with respect to the engine and the fuel delivery adjusted before adjusting the governor.
   Block control rod using following procedure:

2. Control-lever operation

   Before moving the control lever to the maximum-speed position, increase pump speed to 500 - 600 min^{-1} with control lever held in idle position.

Increase pump speed to 500 - 600 min^{-1} with control lever held in idle position, then move control lever to maximum-speed position. As next step, set control rod with the aid of the full-load adjusting screw to 3 mm beyond the full-load position. Various settings can now be made with the control rod blocked in the prescribed position.

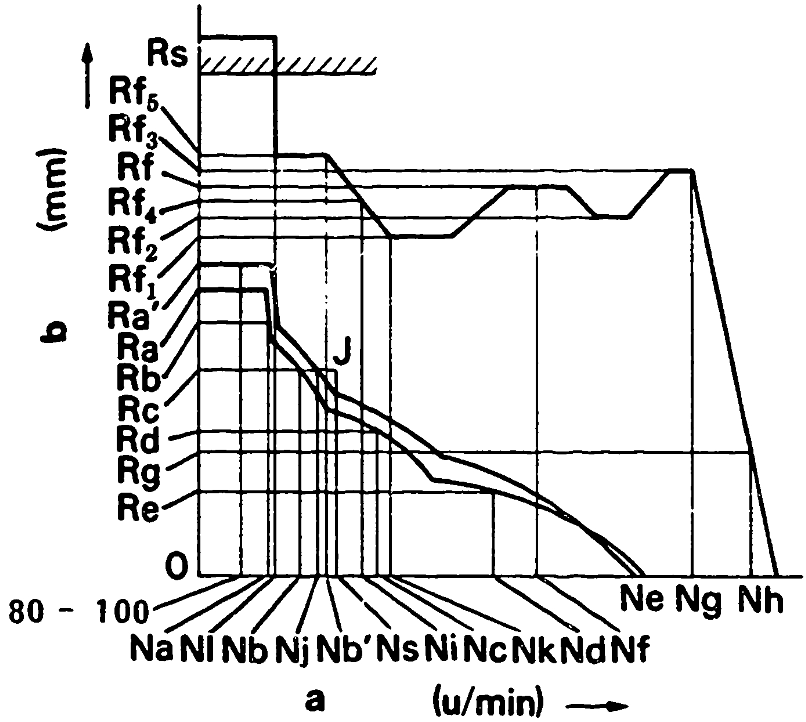
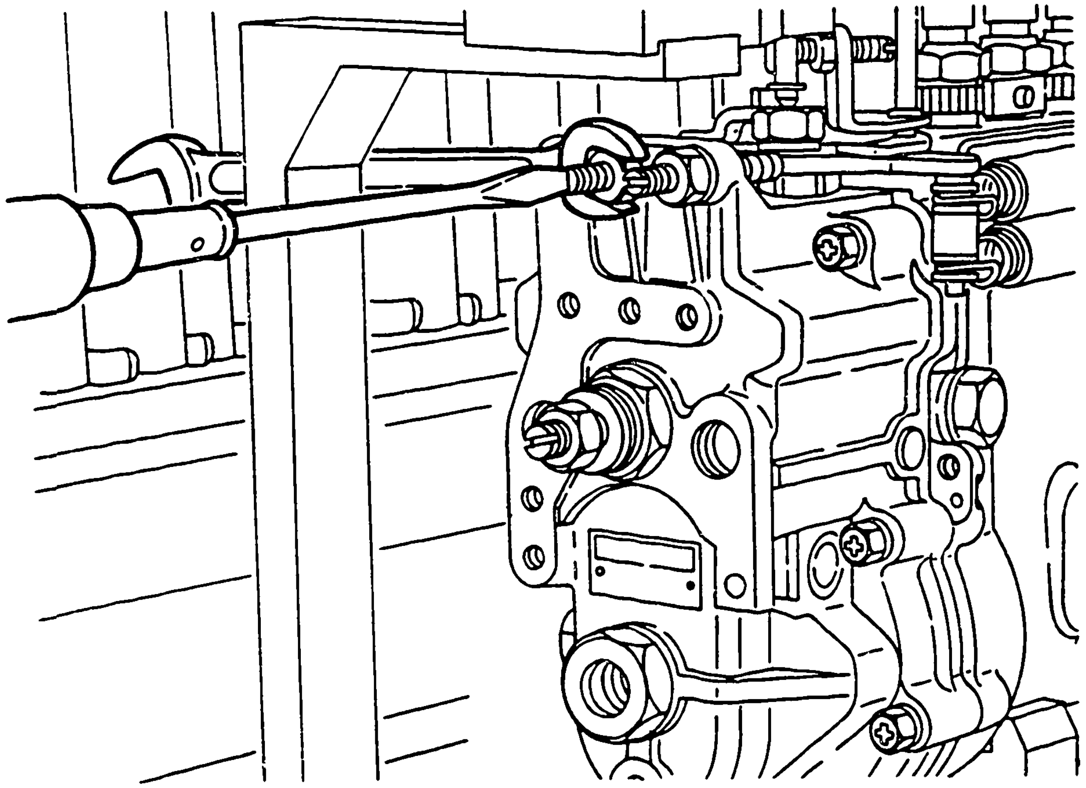


Fig. 89: Governor map

a = Pump speed
b = Control-rod travel

3. The operating behaviour of the governor is a function of the engine operating conditions.

   The governor map shown in Fig. 89 is typical of this governor.



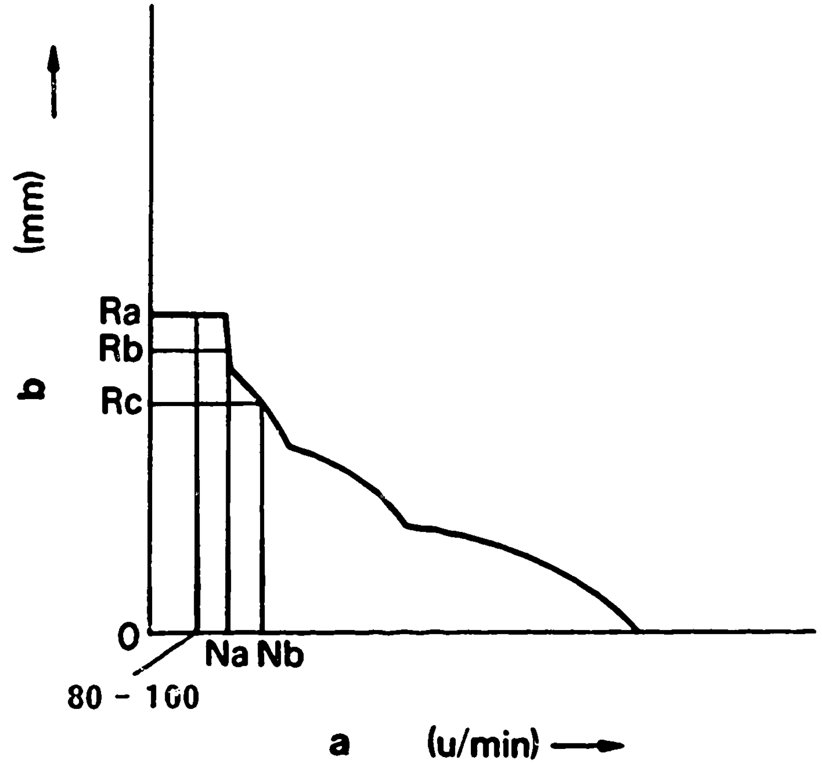


Fig. 90: Temporary adjustment of control lever

Fig. 91: a = Pump speed
b = Control-rod travel

Adjustment procedure

Idle adjustment

1. Temporarily adjust control lever
   Hold pump speed at 80 - 100 min^{-1} and adjust idle-speed adjusting screw (174) (Figs. 90 and 91) such that control rod is in position Ra.

Note:
Make sure that the control-lever angle corresponds to the specifications.

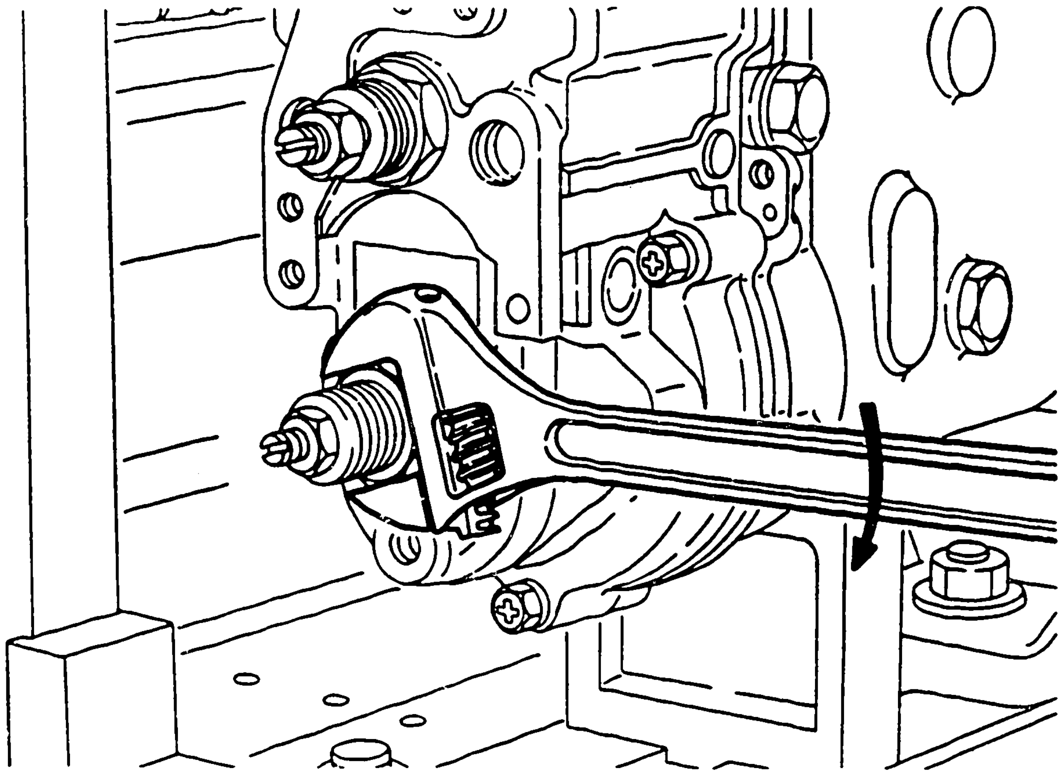


Fig. 92: Adjusting outer idle spring

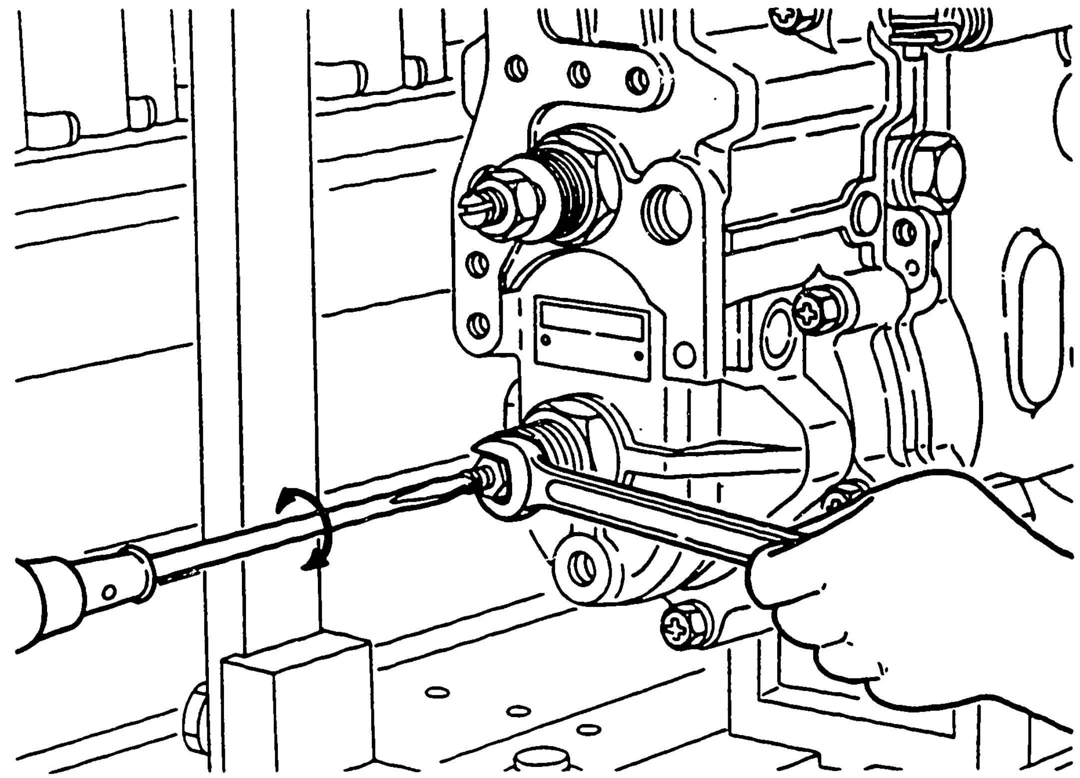


Fig. 93: Adjusting inner idle spring

2. Idle-spring adjustment

1) Screw spring retainer (133) inwards until control rod is in position Rb with pump speed increased to Na min^{-1}. Then tighten nut (135). The outer idle spring has now been set.

2) After increasing the pump speed to Nb min^{-1}, adjust screw (133/2) such that control rod is in position Rc; then tighten lock nut (133/5). The inner idle spring has now been set.

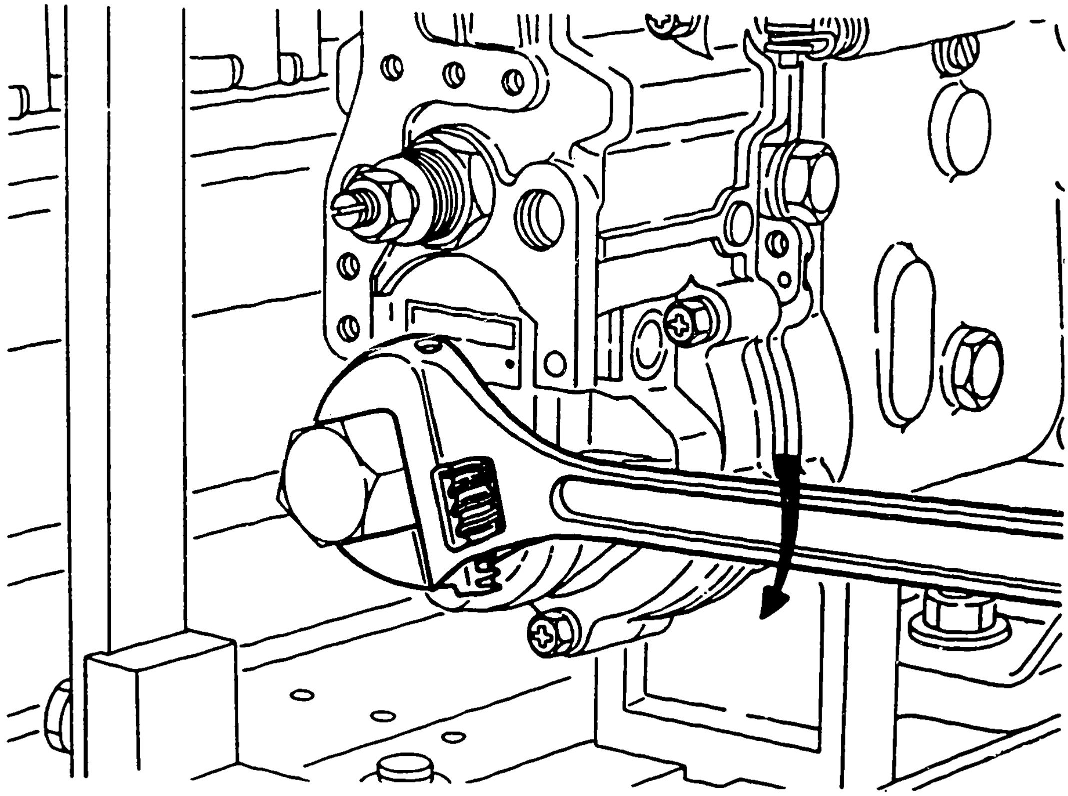


Fig. 94: Screwing on cap nut

3. Provide spring retainer with seal (136) and screw on cap nut (137).

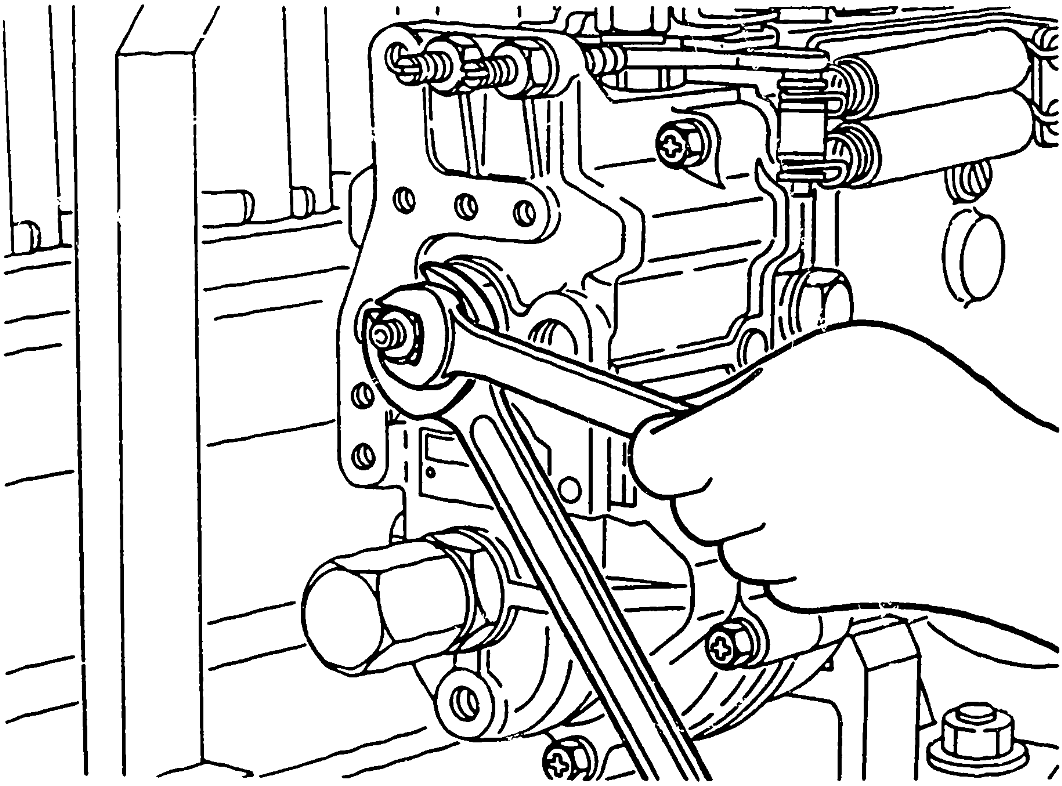


Fig. 95: Adjusting governor springs

4. Governor-spring adjustment

   1) Check whether the distance between the end of the guide screw (141) and the outside of the governor cover is 13.5 - 14.5 mm (Fig. 80).

Note:
If the distance is greater than 14.5 mm, it is difficult to adjust the governor spring with the two nuts (145 and 146). If, on the other hand, the distance is less than 13.5 mm, the spring seat of the tensioning lever makes contact with the guide screw. If this is the case, the flyweights cannot attain their maximum stroke.

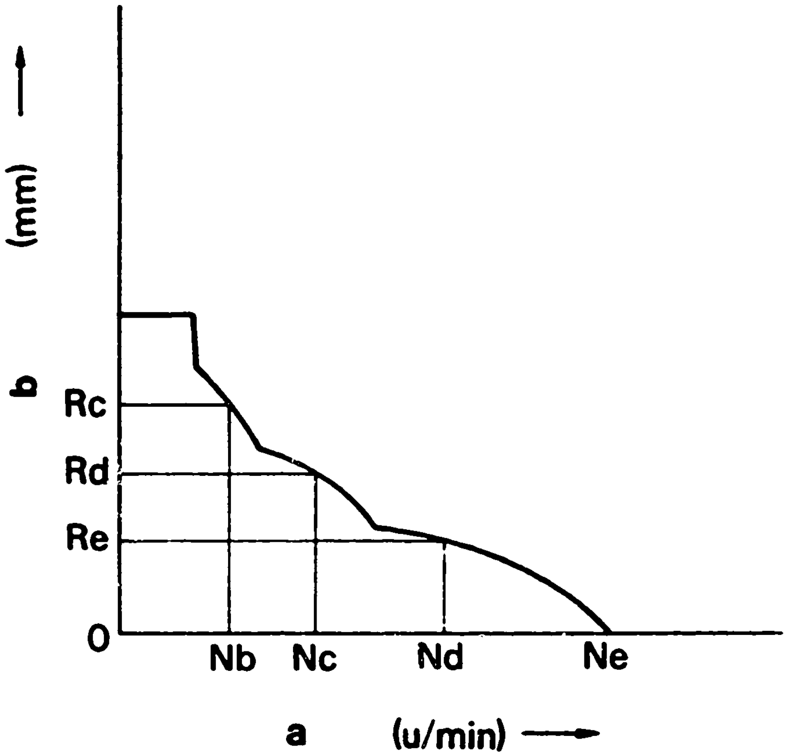


Fig. 96:

a = Pump speed
b = Control-rod travel

2) Block control lever in idle position.

3) With pump speed held at Nc min^{-1}, adjust nut (145) such that control rod is in position Rd; then lock nut (145) with nut (146) against governor shaft (140).

4) Increase pump speed until control rod is in position Re. Then check whether pump operates at Nd min^{-1}.

Note:

The adjustment sequence can be reversed. Set to Re mm at Nd min^{-1} and check whether the speed is Nc min^{-1} with Rd mm.

5) Further increase pump speed until control rod reaches zero position and check that pump runs at Ne min^{-1}.

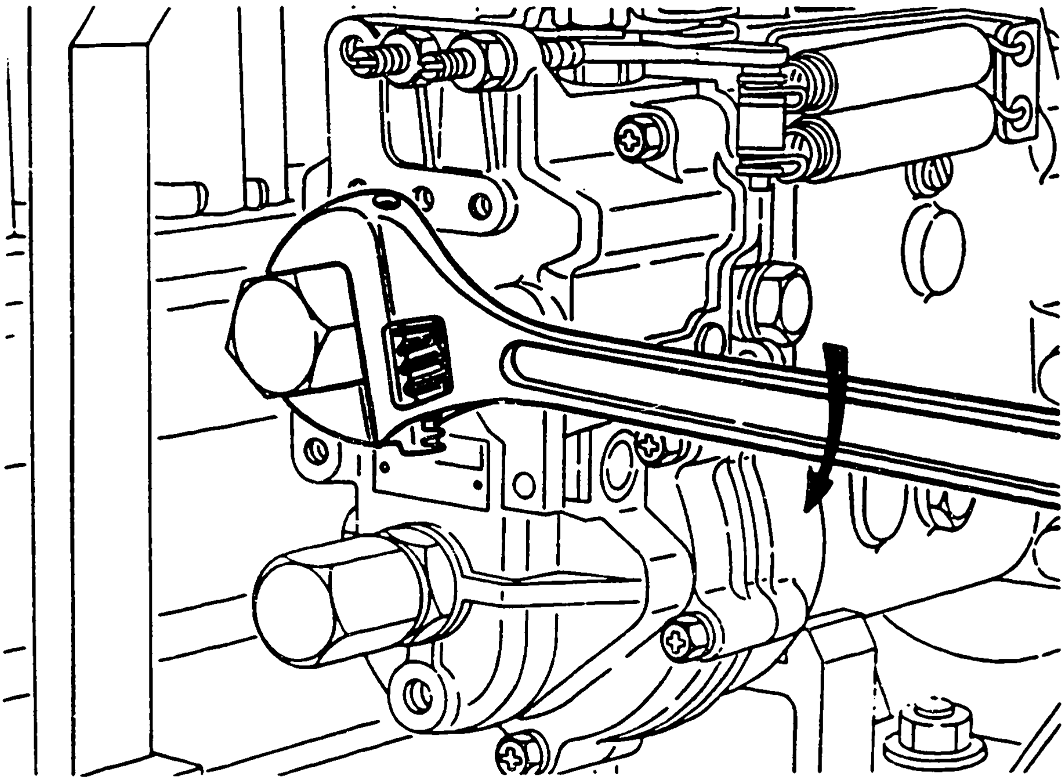


Fig. 97: Screwing on cap nut

5. Attach seal (148) and cap nut (149) to guide screw (141).

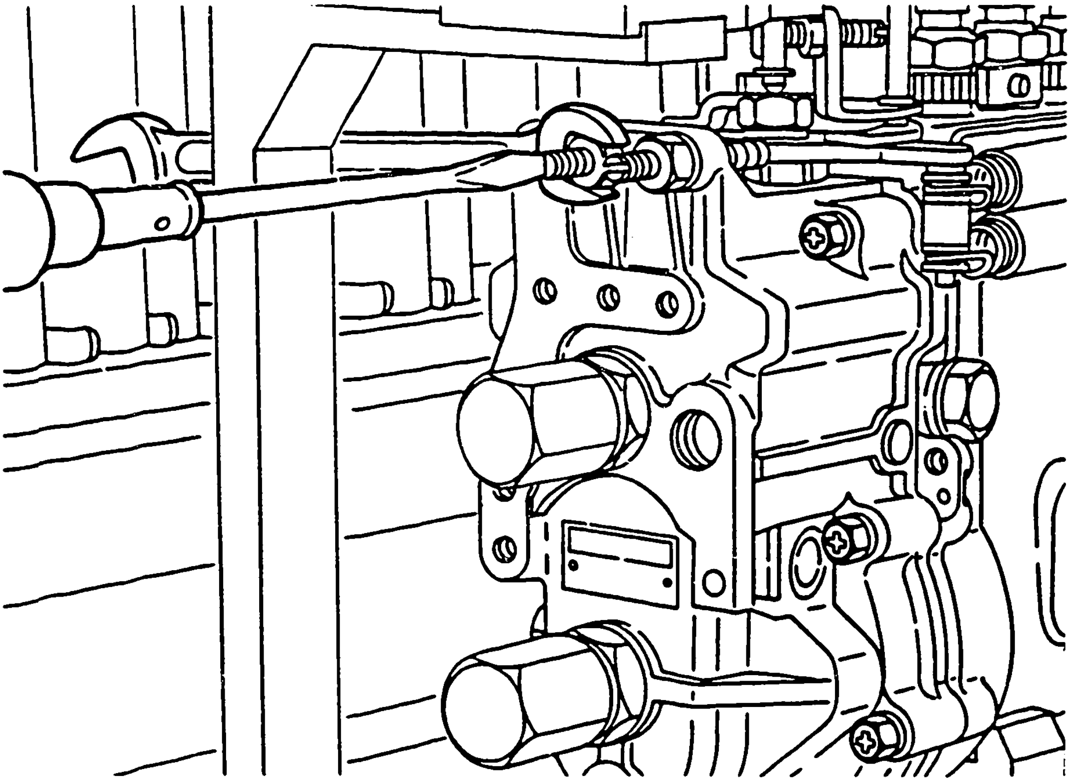


Fig. 98: Adjusting idle-speed adjusting screw

6. Idle adjustment

1) Reduce pump speed to Nb' min^{-1} and adjust idle-speed adjusting screw (174) such that control rod is in position Rc mm. Lock with nut (177).

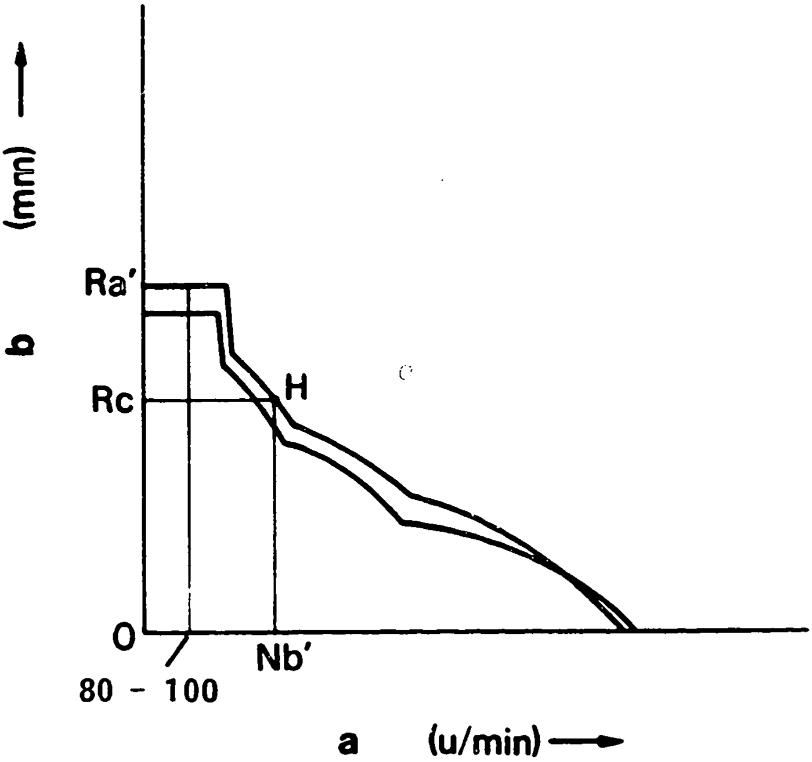


Fig. 99:

a = Pump speed
b = Control-rod travel

2) Further reduce pump speed to 80 - 100 min^{-1} and check whether control rod is in position Ra'.

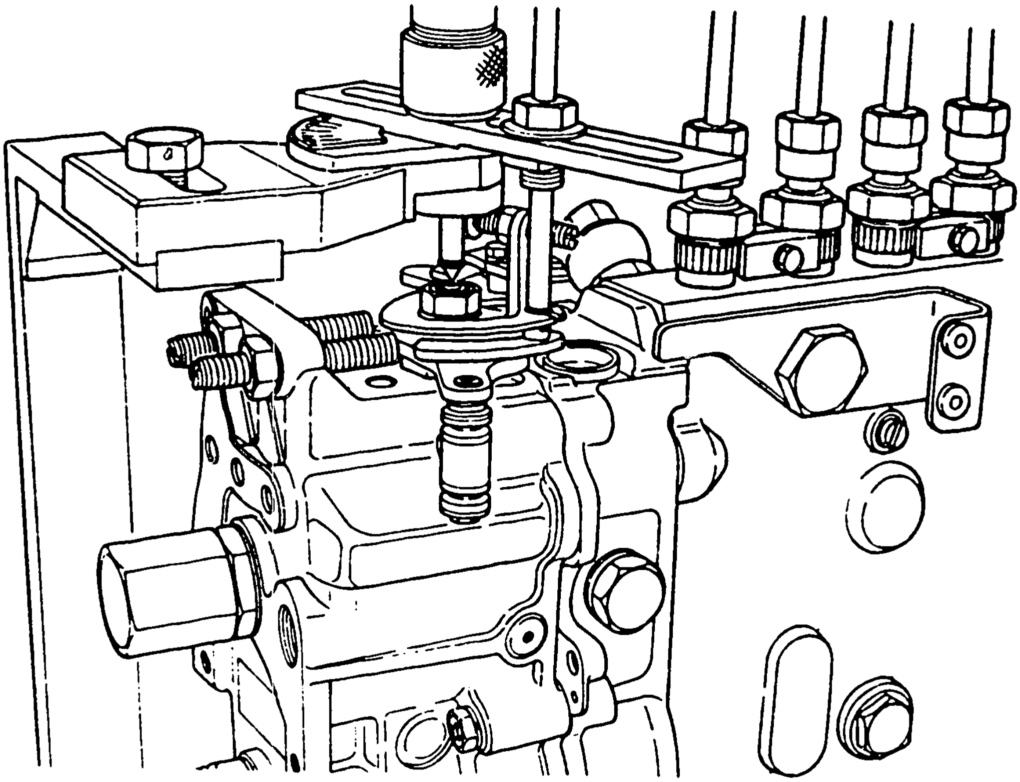


Fig. 100 Temporary adjustment of control lever

Setting full-load position of control rod

1. With pump speed held at Nf min^{-1}, temporarily set control lever to position where lever makes contact with maximum-speed adjusting screw (175).

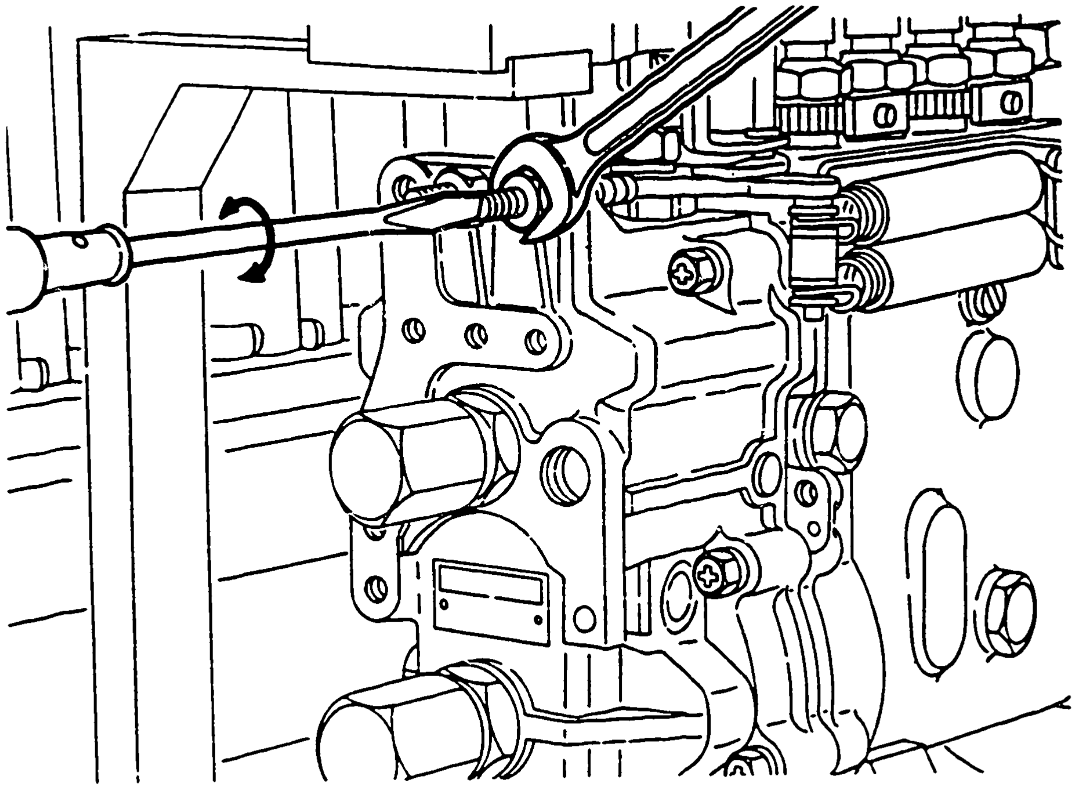


Fig. 101: Adjusting maximum-speed adjusting screw

2. Adjust maximum-speed adjusting screw such that at pump speed Ng min^{-1} the control rod starts to move in the direction of reduced delivery. Then lock maximum-speed adjusting screw with nut.

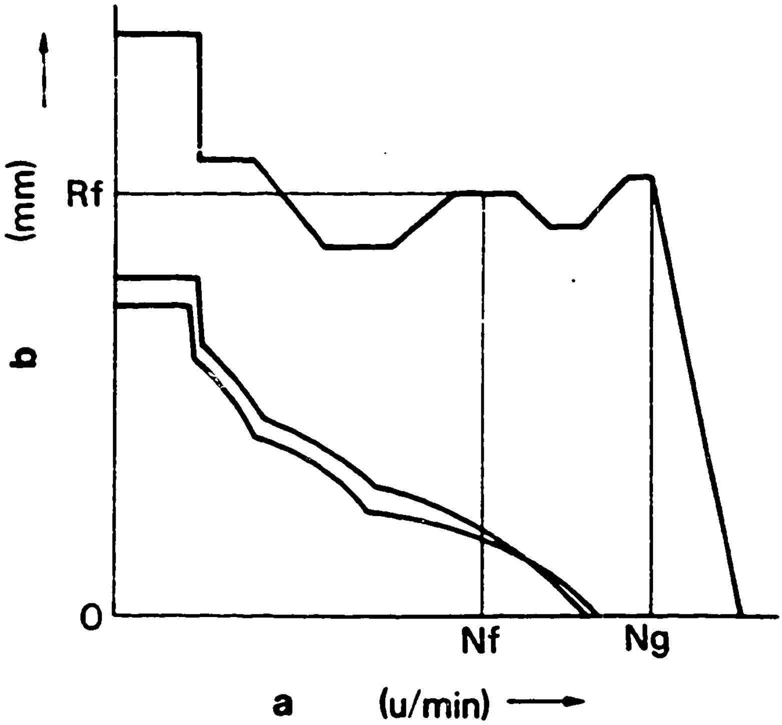


Fig. 102:

a = Pump speed
b = Control-rod travel

3. Adjust full-load adjusting screw (173) such that control rod is in position Rf mm if pump speed is Nf min^{-1}.

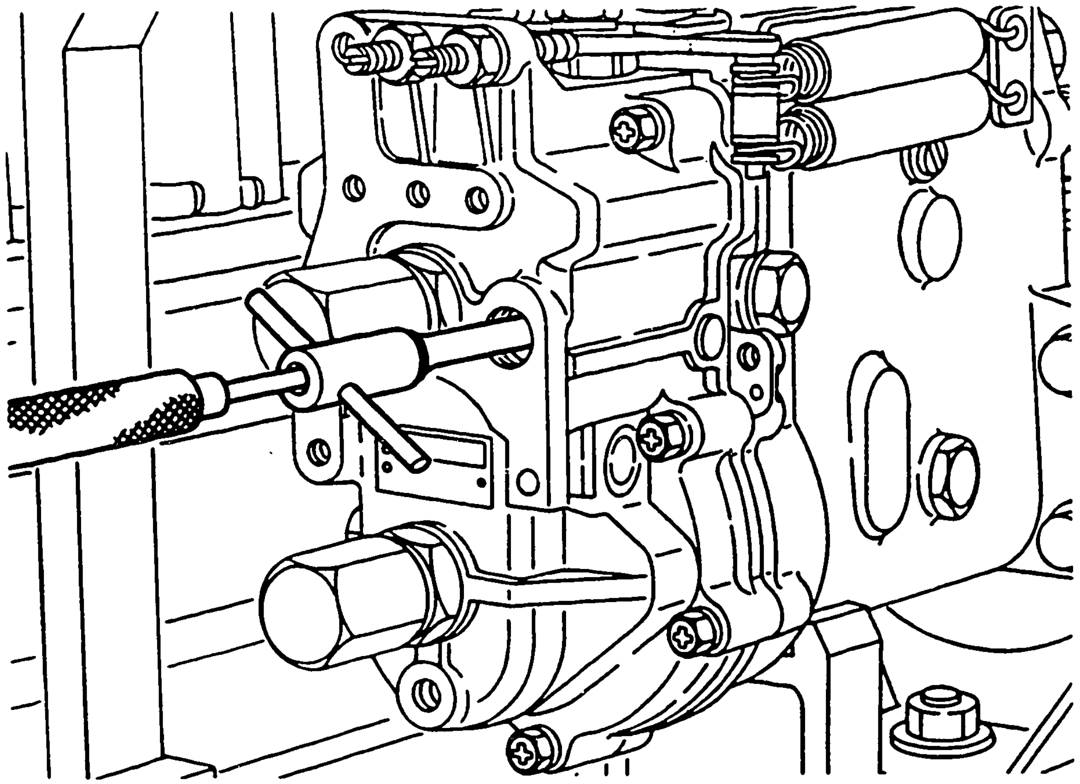


Fig. 103: Adjusting torque-control edge cam

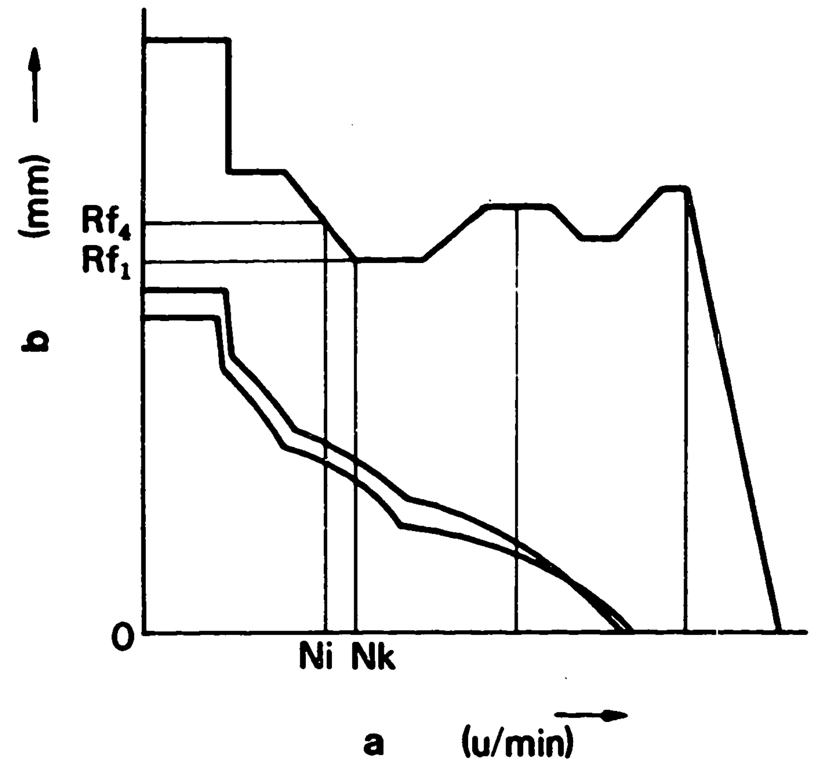


Fig. 104

a = Pump speed
b = Control-rod travel

4. Adjusting torque-control edge cam

   1) Use special wrench (7 mm) to set adjusting nut (35/4/3) such that control rod is in position Rf 4 mm at pump speed Ni min^{-1}. Lock adjusting nut with securing screw (35/4/4).

Note:

Depending on which is more appropriate, the torque-control edge cam can be set at either a pump speed of Nk min^{-1} or Ni min^{-1}.

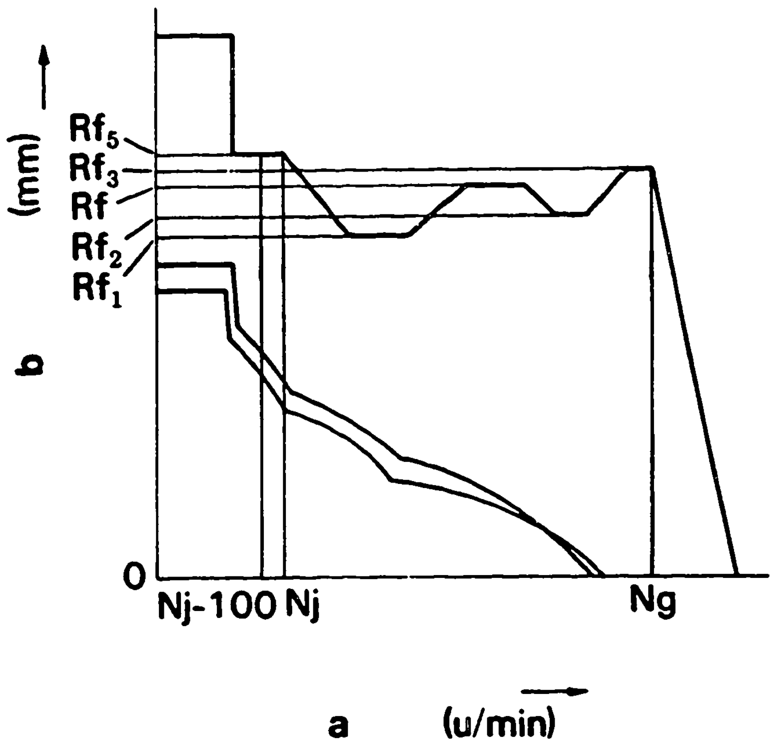


Fig. 105: Checking torque-control edge-cam travel

a = Pump speed
b = Control-rod travel

2) Reduce pump speed to Nj minus approx. 100 min^{-1}; then increase to Ng min^{-1}, in order to establish whether the adjustment travel of the torque-control edge cam is within the prescribed range. If the torque-control edge-cam travel is incorrect, replace torque-control edge cam.

Note:

Before fitting a new torque-control edge cam, make sure that the punch mark has the same number indicated in the adjustment specifications.

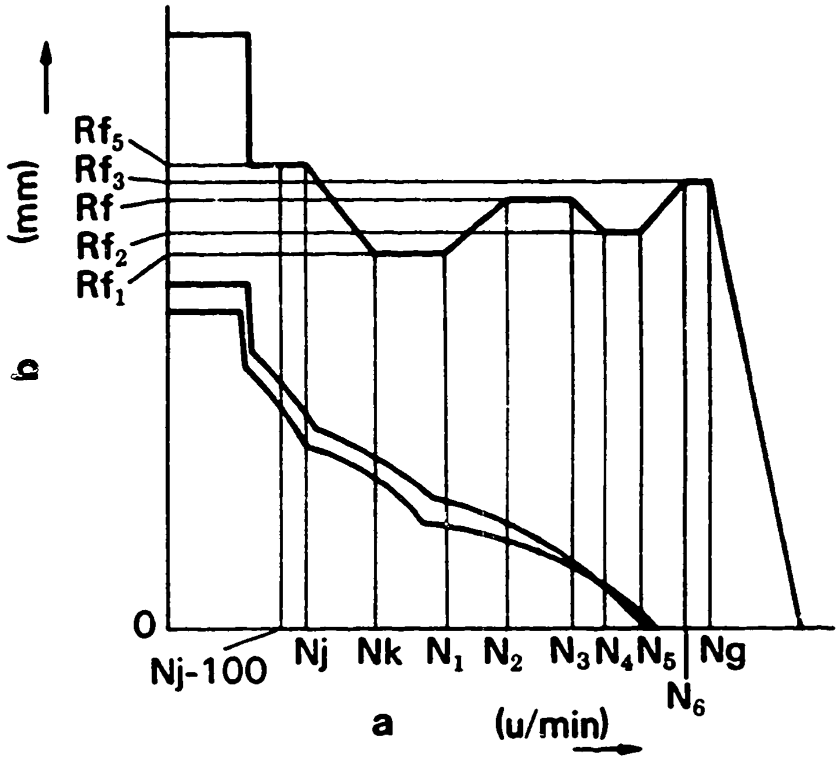


Fig. 106: Checking prescribed pump speed

a = Pump speed
b = Control-rod travel

3) As next step, increase pump speed from Nj minus approx. 100 min^{-1} to Ng min^{-1}; then check whether pump speed is in line with specifications in all control-rod positions. If the pump speed is not correct, the torque-control edge cam has not been properly set and needs readjusting. If the prescribed pump speed cannot be attained by adjusting the torque-control edge cam, it is to be replaced.

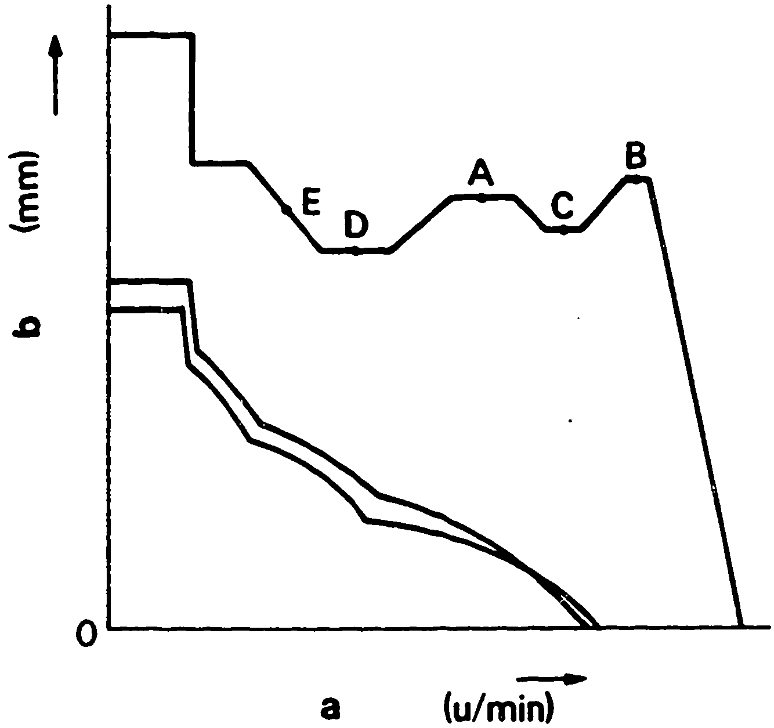


Fig. 107

a = Pump speed
b = Control-rod travel

5. Measure fuel delivery at each of the adjustment points A, B, C and others (delivery values for full load). If the delivery is incorrect, carefully adjust full-load adjusting screw and adjusting nut of torque-control edge cam. Following adjustment, secure nut and screw.

Note:
If this setting has not been properly performed, the prescribed delivery will not be attained. The engine does not reach full power and produces black exhaust smoke.

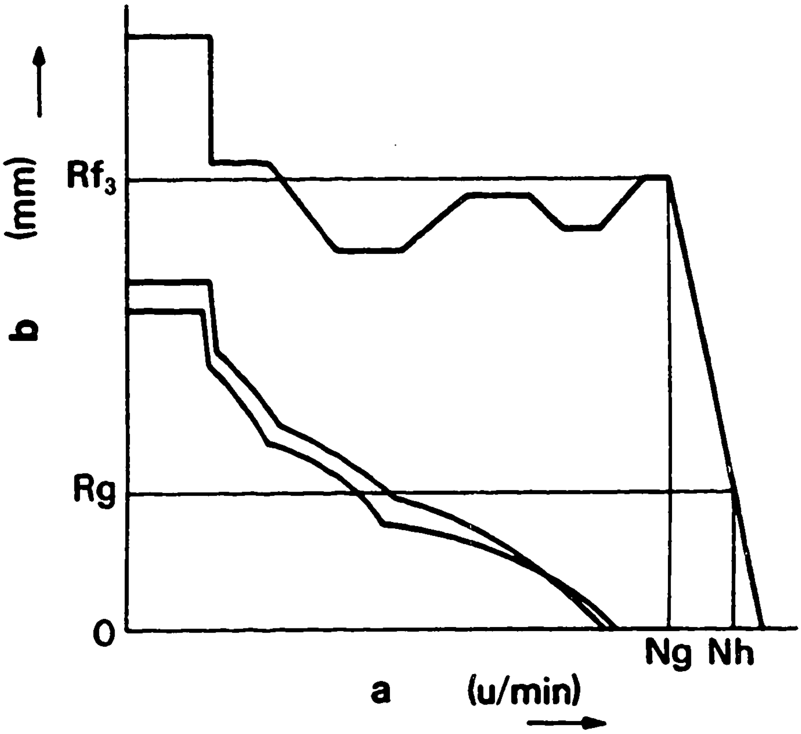


Fig. 108

a = Pump speed
b = Control-rod travel

Adjusting full-load speed regulation

1. Block control lever at maximum-speed adjusting screw.

2. With pump speed held at Ng min^{-1}, adjust maximum-speed adjusting screw such that control rod starts to move from Rf 3 mm in direction of reduced delivery. Then lock screw with nut.

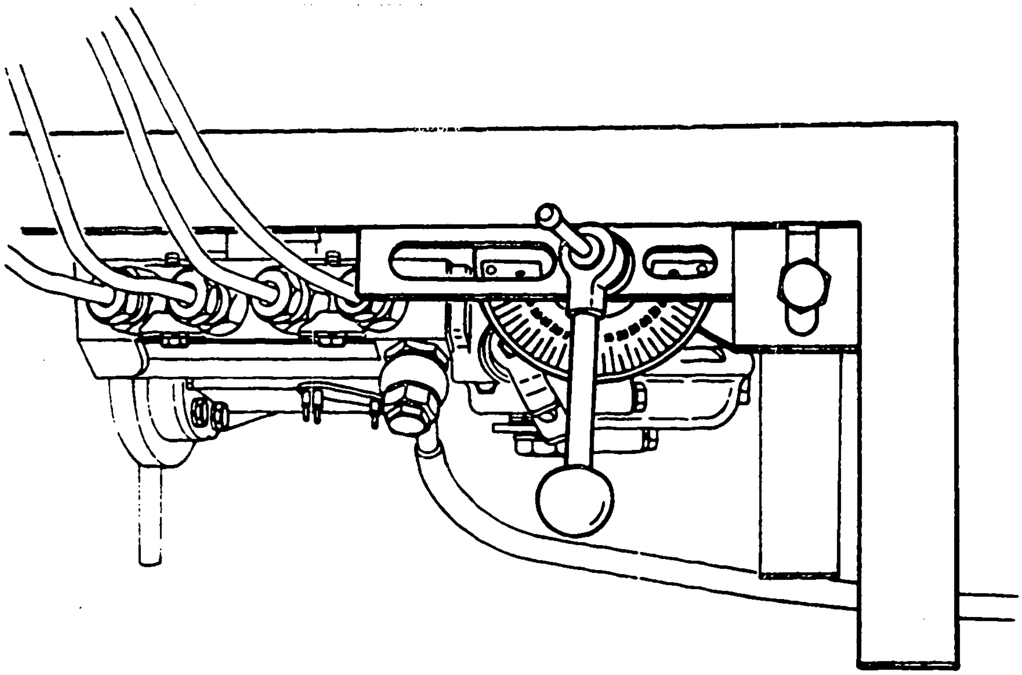


Fig. 109

3. Check upper speed droop.
   Gradually increase pump speed and check whether pump speed is Nh min^{-1} when control rod reaches Rg mm.

4. Further increase pump speed and establish whether control rod reaches 0 mm.

5. Use setting device (KDDC 0018) to check whether control-lever angle is in line with specifications.

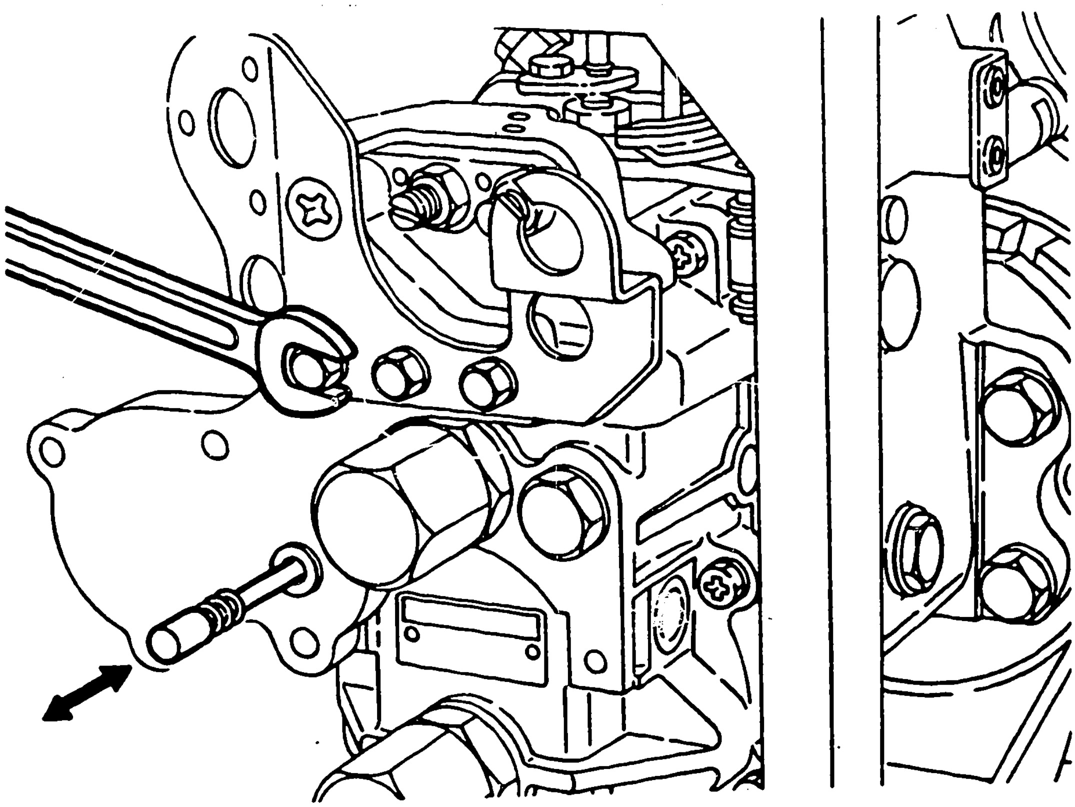


Fig. 110: Checking movement of thrust pin

Adjusting manifold-pressure compensator

If the governor has no manifold-pressure compensator, proceed to Section "Confirming limit value for starting fuel delivery".

1. Attach spacer plate (1A) to governor cover and check whether thrust pin can move freely.

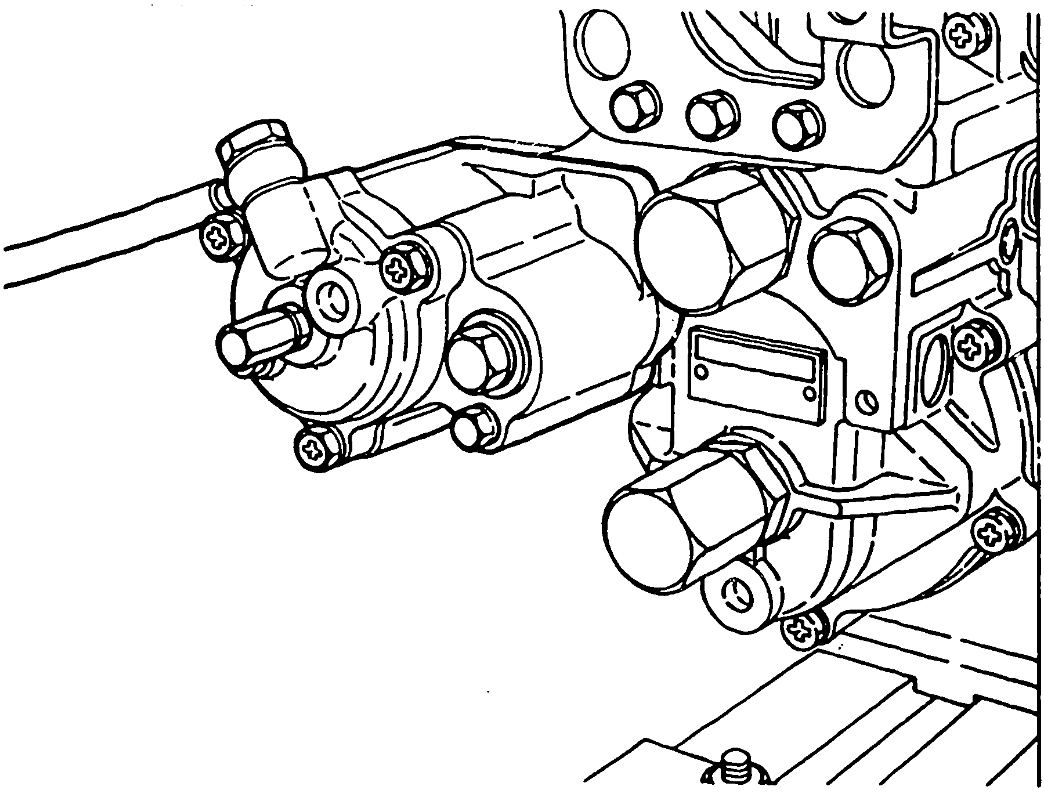


Fig. 111: Attaching manifold-pressure compensator

2. Attach manifold-pressure compensator and connect up charge-air hose.

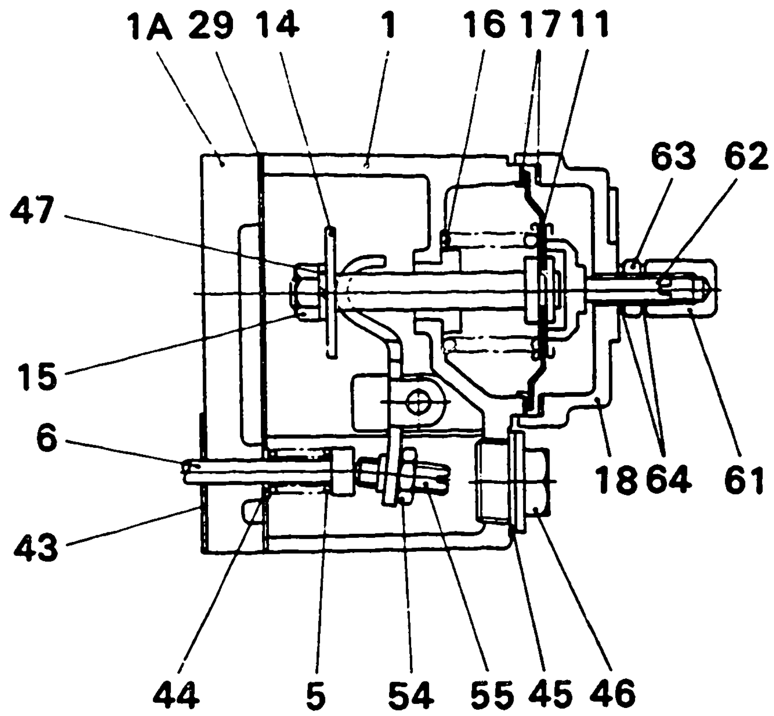


Fig. 112

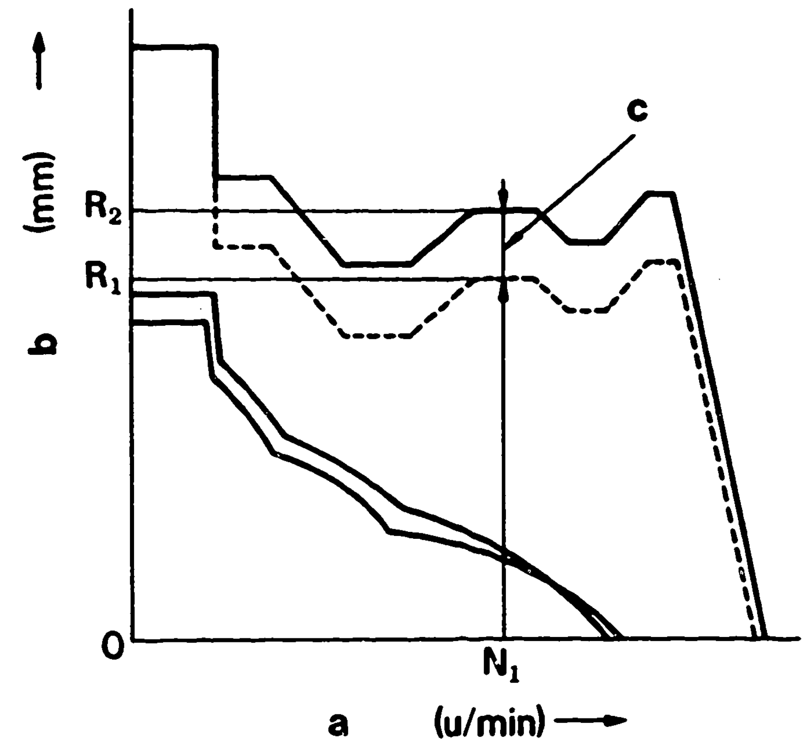


Fig. 113. a = Pump speed
b = Control-rod travel
c = Adjustment travel of manifold-pressure compensator

3. Setting adjustment travel of manifold-pressure compensator.

1) Screw in screw (62) as far as it will go, so that thrust pin (6) can attain its maximum adjustment travel.

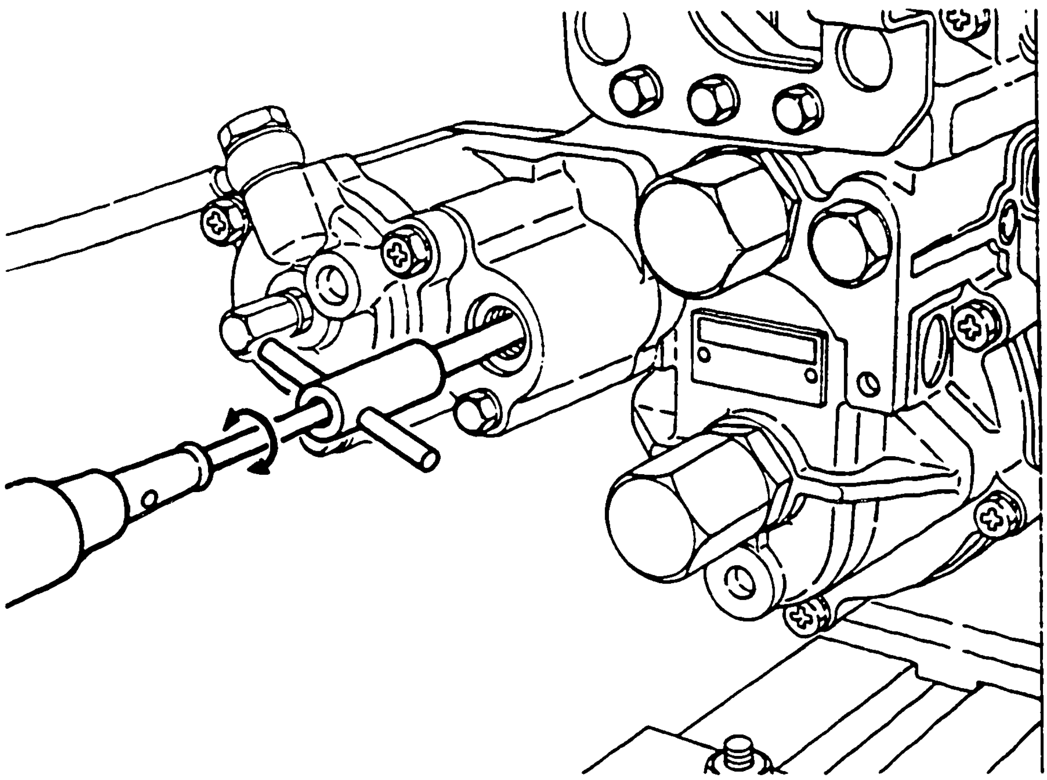


Fig. 114: Setting adjustment travel of manifold-pressure compensator

2) With pump speed held on N1 min^{-1}, shift control rod with screw (55) from R2 mm to R1 mm; then lock screw with nut (54).

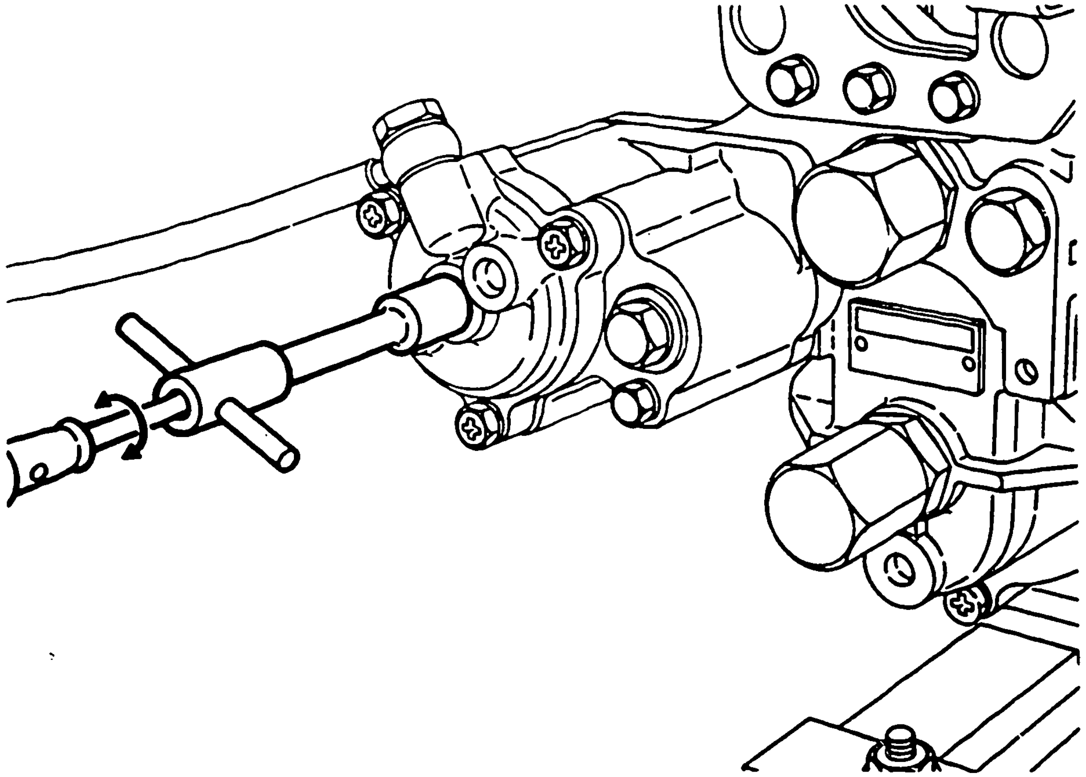


Fig. 115: Adjusting spring of manifold-pressure compensator

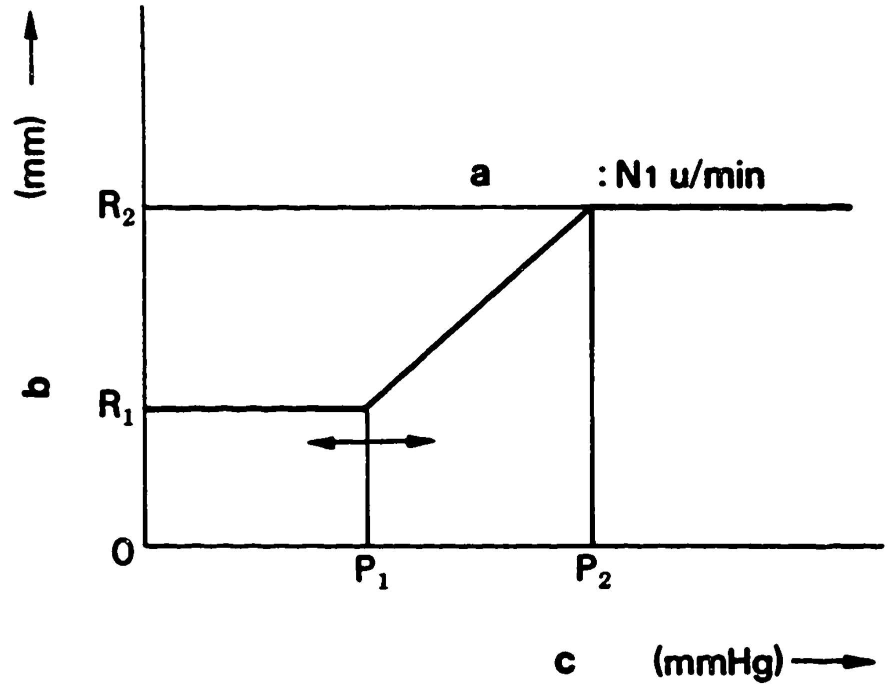


Fig. 116

a = Pump speed
b = Control-rod travel
c = Charge-air pressure

4. Adjusting spring force of manifold-pressure compensator.

   1) With pump speed held at N1 min^{-1}, gradually increase charge-air pressure after loosening screw (62).

   2) Set screw (62) such that control rod starts to move from R1 mm in direction of increased delivery when charge-air pressure attains P1 mmHg.
      Lock screw with nut (63).

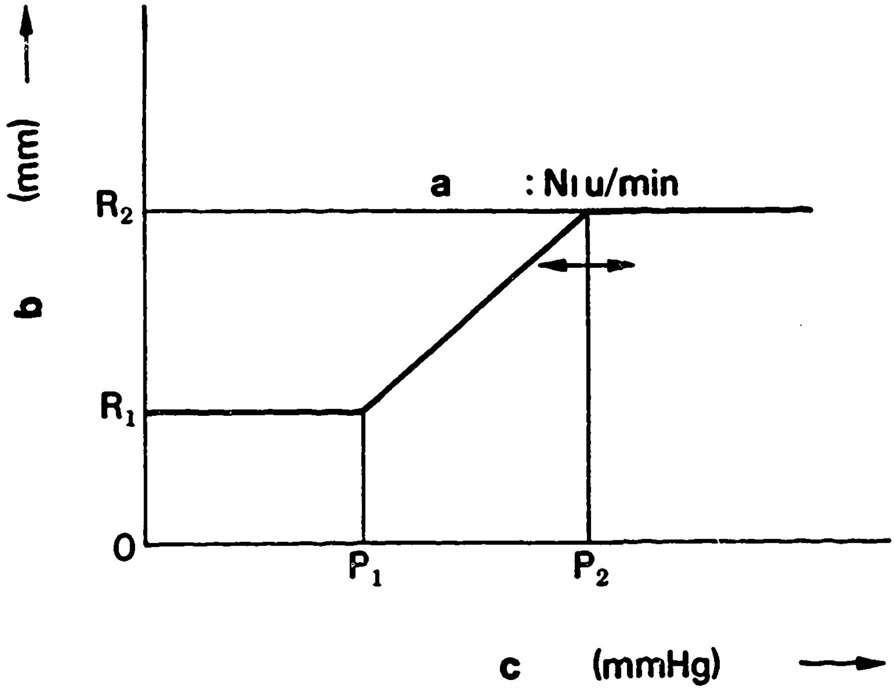
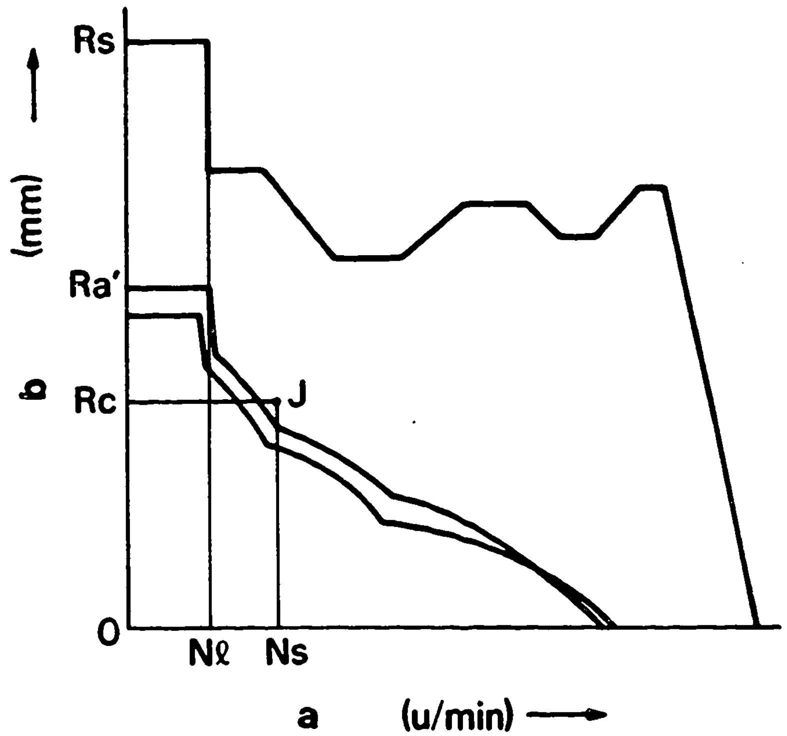


Fig. 117

a = Pump speed
b = Control-rod travel
c = Charge-air pressure

3) Increase charge-air pressure and check whether it reaches P2 mmHg with control rod in position R2 mm. If the charge-air pressure does not attain P2 mmHg, replace spring (16).



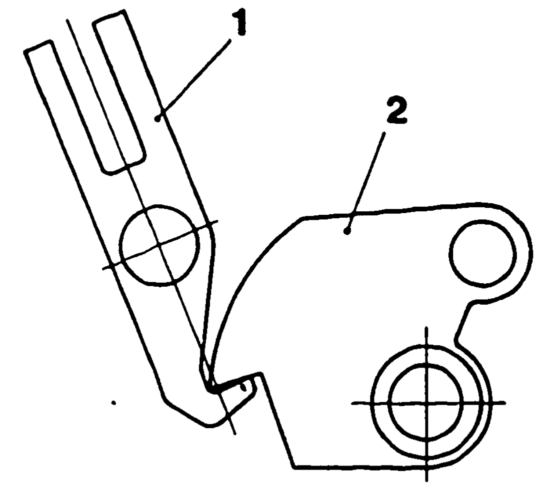


Fig. 118

a = Pump speed
b = Control-rod travel

Fig. 119

1 = Sensing lever
2 = Torque-control edge cam

Confirming limit value for starting fuel delivery

1. With pump speed held at Ns min^{-1}, block control lever in control-rod position Rc mm.

2. Check whether control rod moves beyond Ra' mm if pump speed is reduced to 0 min^{-1}.

3. Check whether control rod moves beyond Rs mm if control lever is moved into maximum-speed position with pump speed held at Nℓ min^{-1}.
   The above confirmation process is designed to ensure that the sensing lever and the torque-control edge cam assume the position shown in Fig. 119 if the control rod moves beyond Rs mm.

Note:
   The control rod must not move to Rs if the pump speed is reduced to ℓ min^{-1} with the control lever blocked at maximum speed.

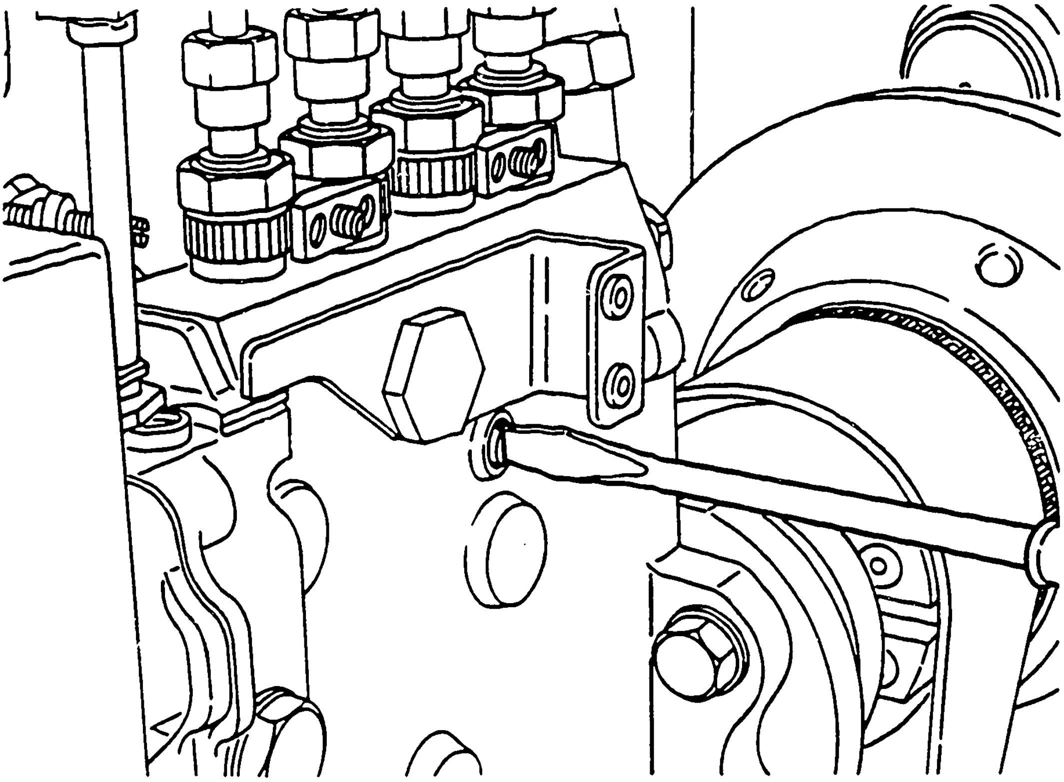


Fig. 120: Screwing out control-rod guide screw

Adjusting control-rod stop

1. Screw control-rod guide screw out of pump housing.

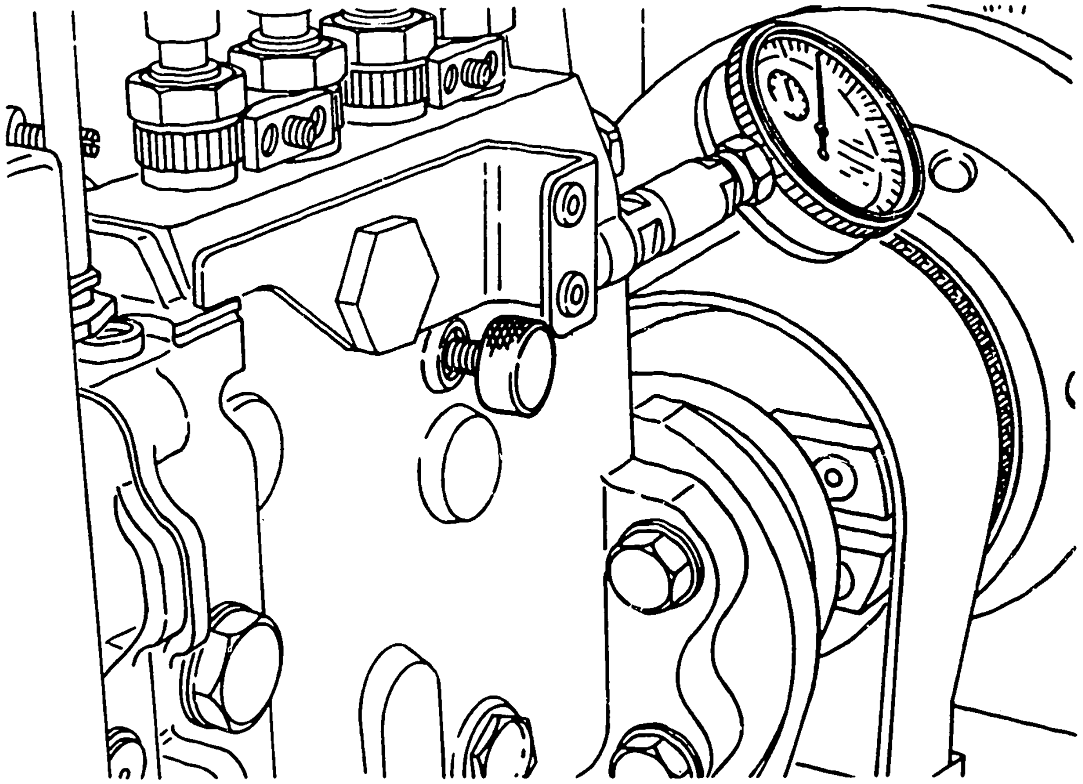


Fig. 121 Clamping control rod

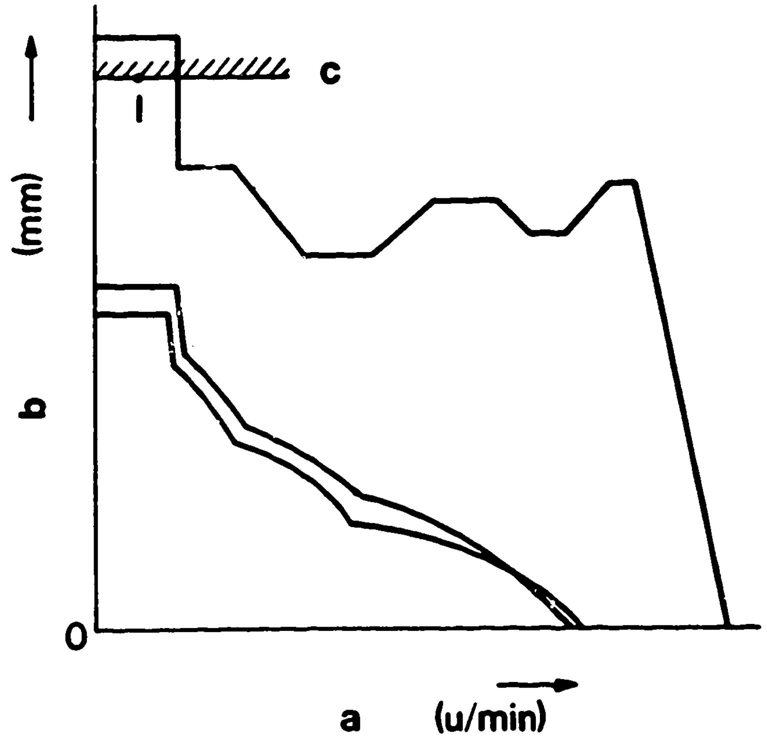


Fig. 122 a = Pump speed
b = Control-rod travel
c = Control-rod stop

2. Clamp control rod in position stated in adjustment specifications whilst holding pump speed on 0 min^{-1}.

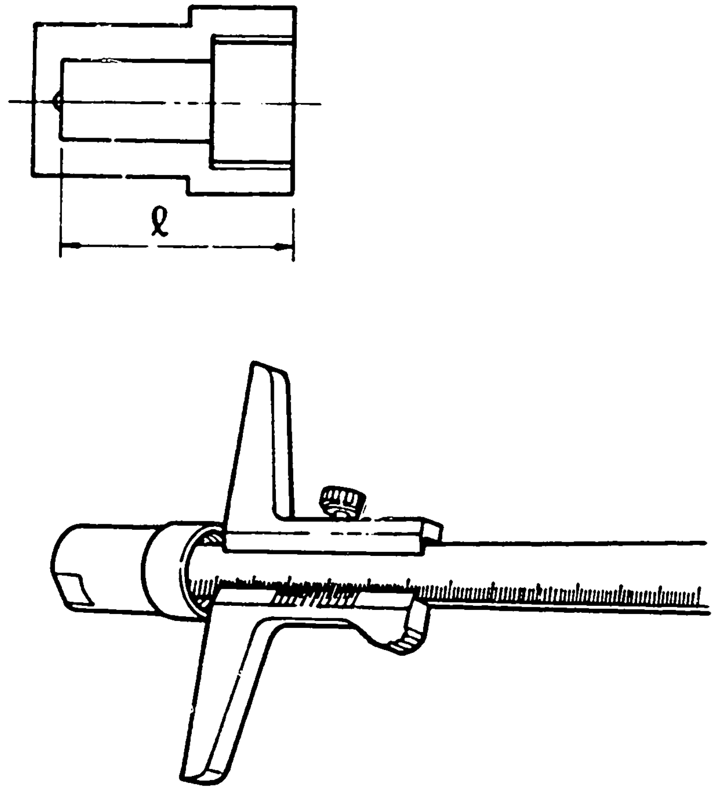


Fig. 123

3. Measure depth "ℓ" of control-rod cap nut (65)

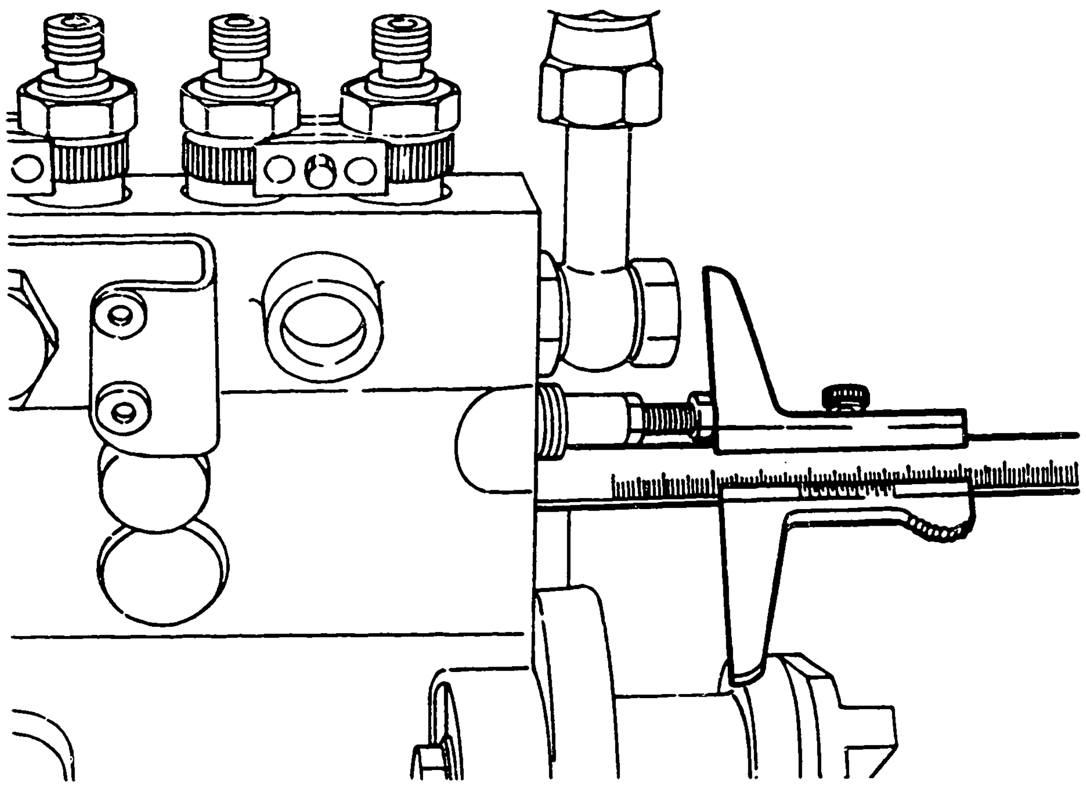


Fig. 124 Measuring spacing "ℓ"

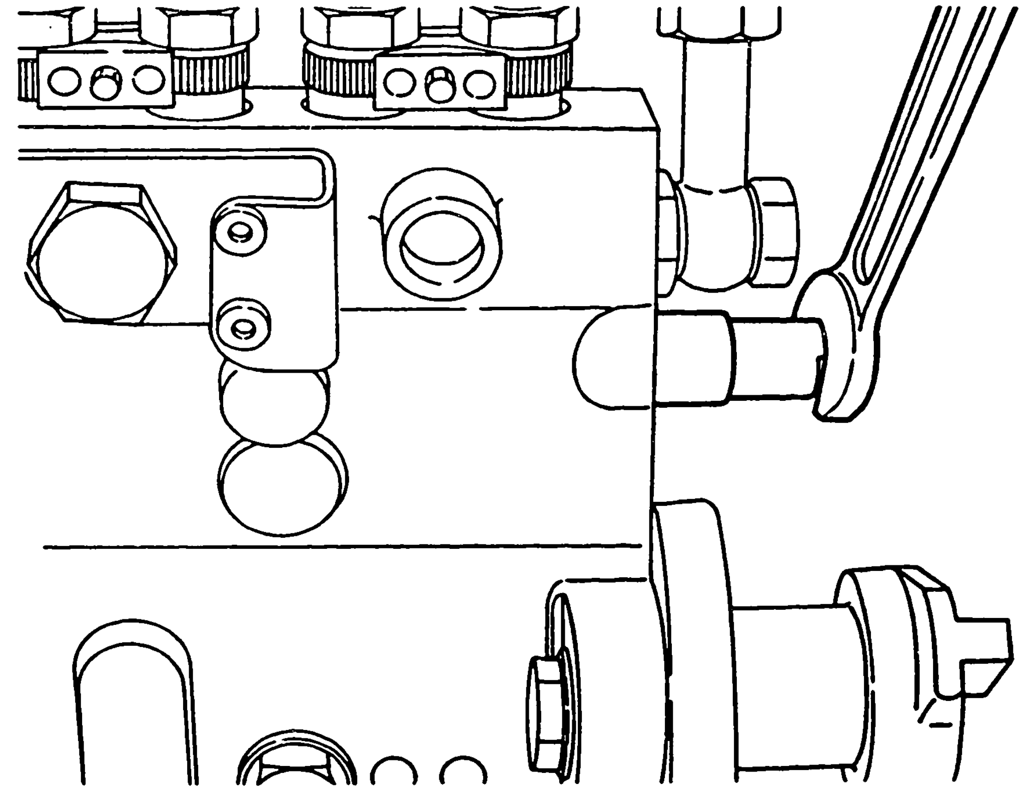


Fig. 125

4. Attach screw and nut to end of control rod.

5. Set screw such that distance between end face of pump housing and upper side of screw head is equal to "ℓ" (depth of control-rod cap nut). Then tighten nut to secure screw and screw on control-rod cap nut.

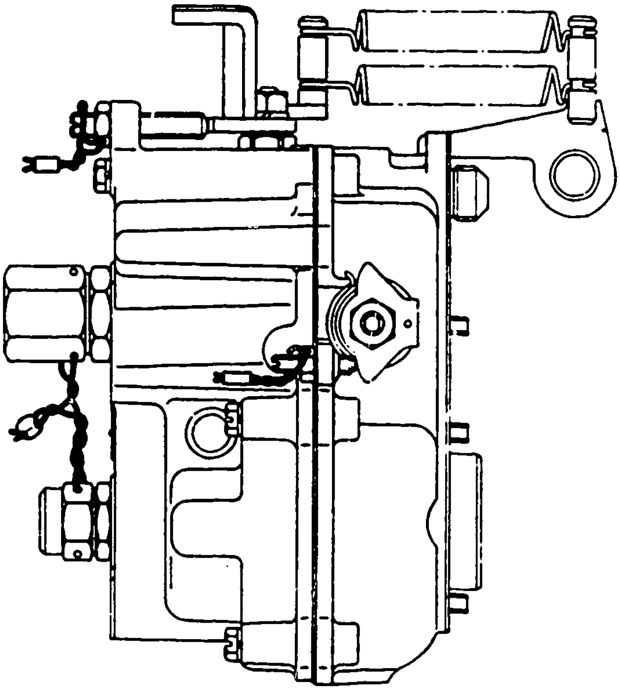


Fig. 126

HANDLING

Sealing governor

Following adjustment, a lead seal is attached to all adjustable stops (screws and nuts) which directly influence the operating behaviour and output of the engine. A stop is never to be adjusted without using the pump test bench or an engine test bench, since this has a detrimental effect on the operating behaviour of the engine and the engine does not reach its maximum output. Furthermore, the engine may be overrevved, overheated and damaged.

Lubricating oil

The component parts of the mechanical system inside the governor housing and in the cam space of the fuel-injection pump are lubricated with engine oil by way of the oil pump. In order to guarantee long-term, optimal operating behaviour of the injection pump, the engine oil must be checked carefully and at frequent intervals and replaced regularly as prescribed by the engine manufacturer.

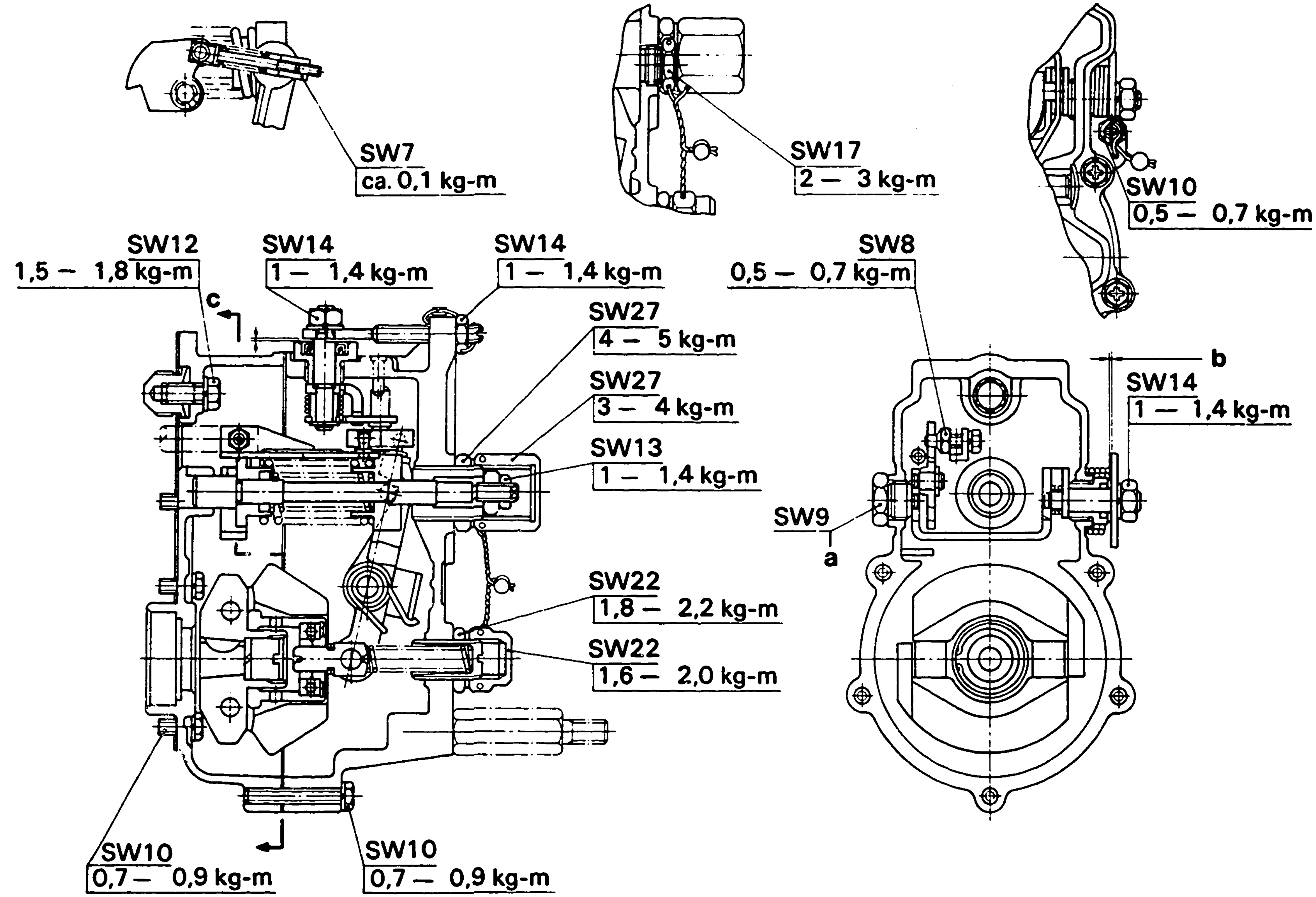


Fig. 127

TIGHTENING TORQUES

a = Apply liquid adhesive before screwing in and tightening
b = Play: less than 0.1
c = Play: less than 0.1

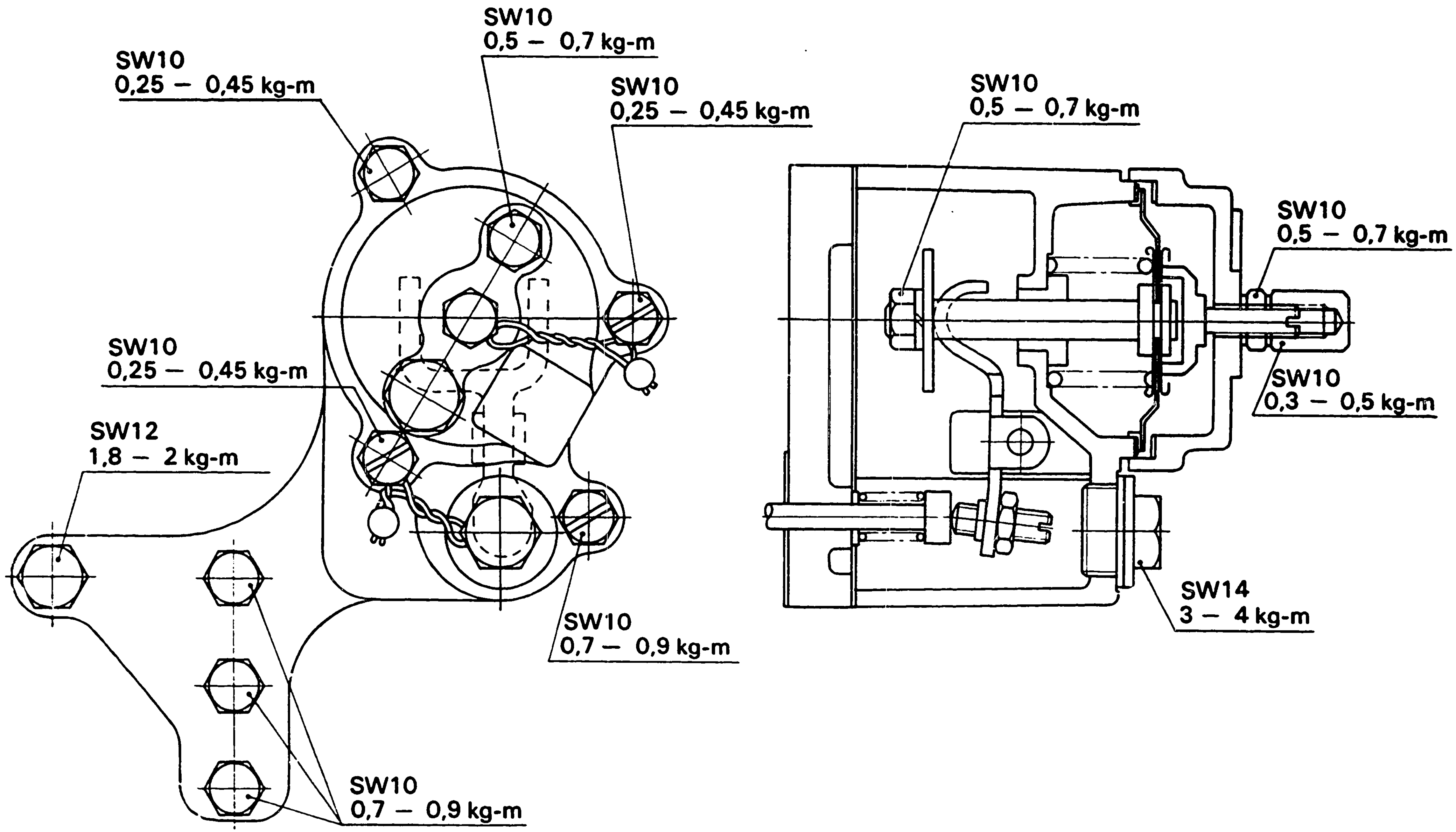


Fig. 127-1

Tightening torques

TYPE DESIGNATION

```
(Example)  1 0 5 9   3    1  -  0 9 3   0
              |      |    |       |     |
             (1)    (2)  (3)     (4)   (5)
```

(1) Type RLD mechanical governor
(2) Attachment position of governor
    2 .... right side
    3 .... left side
(3) Add-on modules
    0 .... No add-on module
                           (Type RLD governor)
    1 .... with torque-control edge cam
                        (Type RLD-K governor)

(4) Specific number
(5) Modification index

Explanation of part numbers (continued)

BOSCH TYPE DESIGNATION

(Example) NP - EP / RLD 300 - 1850 A 2 C K L N1

NP	EP	RLD	300 - 1850	A	2	C	K	L	N1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

(1) Manufactured by DIESEL KIKI CO., LTD.
(2) For fuel-injection pump
(3) Type RLD mechanical governor manufactured by DIESEL KIKI CO., LTD.
(4) Regulated speed range and control process
(5) Pump size
A .... Type PE-A (D) fuel-injection pump
(6) Weight of flyweights
1: 740 g
2: 640 g
3: 540 g
(7) Governor type
A .... Type RLD-A governor
B .... Type RLD-B governor
C .... Type RLD-C governor
(8) Additional functions
O .... No additional functions
K .... With torque-control edge cam
F .... With torque-control edge cam and shutoff device
M .... With torque-control edge cam and manifold-pressure compensator
X .... With torque-control edge cam, manifold-pressure compensator and shutoff device
(9) Installation position
R .... Pump installed on right side
L .... Pump installed on left side
(10) Modification index

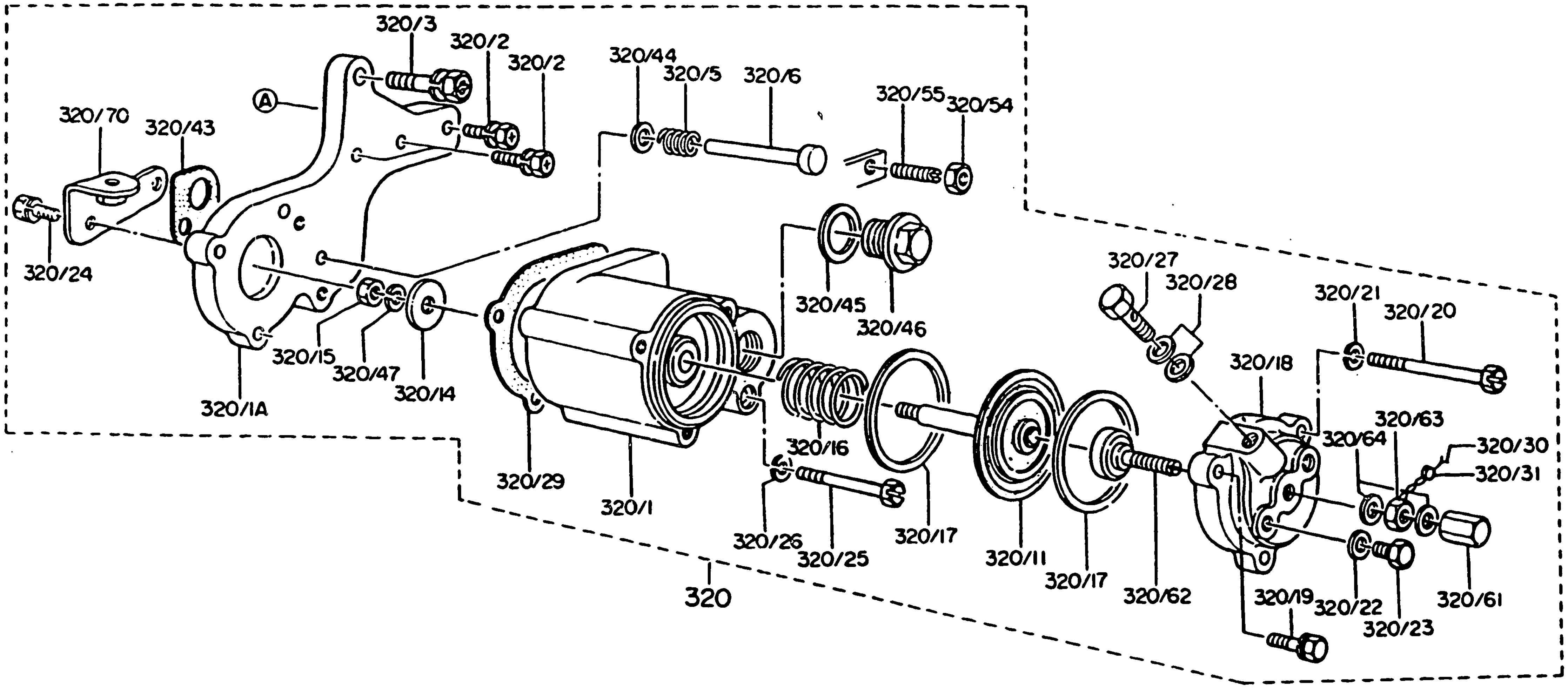


Fig. 128

COMPONENT PARTS OF TYPE RLD (K) GOVERNOR WITH MANIFOLD-PRESSURE COMPENSATOR

320	Manifold-pressure compensator
320/1	Housing
320/1A	Spacer plate
320/2	Screw
320/3	Screw
320/5	Spring
320/6	Thrust pin
320/11	Diaphragm
320/14	Washer
320/15	Nut
320/16	Spring
320/17	Seal
320/18	Cover
320/19	Screw
320/20	Screw
320/21	Spring lock washer
320/22	Seal
320/23	Screw plug
320/24	Screw
320/25	Screw
320/26	Spring lock washer
320/27	Inlet-union screw
320/28	Seal
320/29	Seal
320/30	Gear
320/31	Lead seal
320/43	Seal
320/44	Washer
320/45	Seal
320/46	Screw plug
320/47	Spring lock washer
320/54	Nut
320/55	Screw
320/61	Cap nut
320/62	Screw
320/63	Nut
320/64	Seal
320/70	Holder

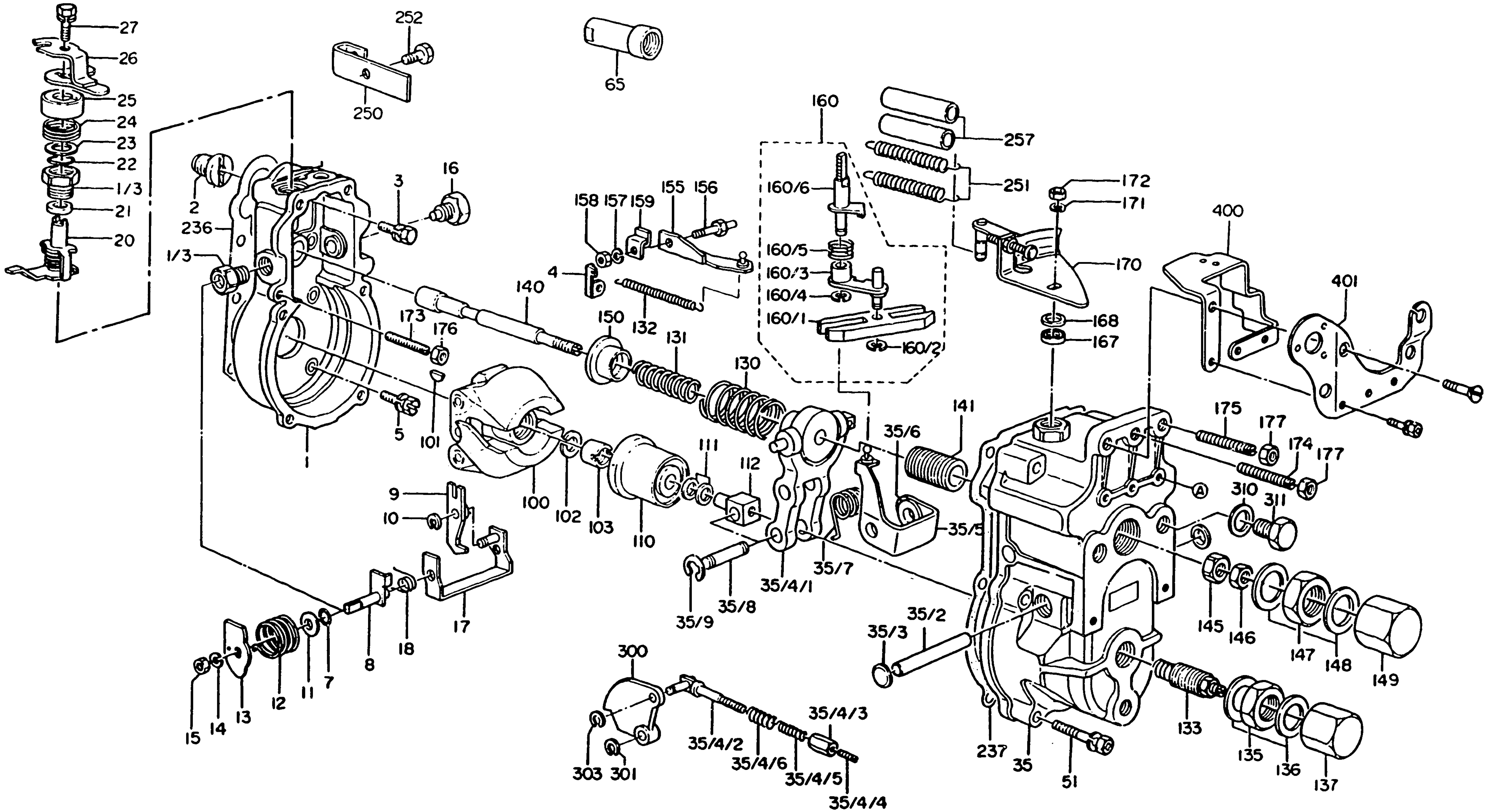


Fig. 128-1 Component parts of type RLD (K) governor with manifold-pressure compensator (continued)

Refer to Coordinate G 18/G 19 for component designations.

COMPONENT DESIGNATIONS

1	Governor housing
1/3	Bushing
2	Adapter
3	Screw
4	Rolled end of spring
5	Screw
7	O-ring
8	Full-load-lever shaft
9	Sensing lever
10	Spring washer
11	Shim
12	Return spring
13	Full-load adjustment lever
14	Spring lock washer
15	Nut
16	Guide screw
17	U-lever
18	Return spring
20	Support lever
21	Ring
22	O-ring
23	Shim
24	Return spring
25	Cap
26	Stop lever
27	Screw
35	Governor cover
35/2	Tensioning-lever shaft
35/3	Plug
35/4/1	Tensioning lever
35/4/2	Connecting rod
35/4/3	Adjusting nut
35/4/4	Securing screw
35/4/5	Inner spring
35/4/6	Outer spring
35/5	Guide lever
35/6	Bushing
35/7	Return spring
35/8	Pin
35/9	Lock washer
51	Screw
65	Control-rod cap nut
100	Flyweight mount with flyweights
101	Woodruff key
102	Spring lock washer
103	Round nut
110	Sliding sleeve, sub-assembly
111	Shim
112	Sliding bolt
130	Outer governor spring
131	Inner governor spring
132	Starting spring
133	Idle spring, sub-assembly
135	Lock nut
136	Seal
137	Cap nut
140	Governor shaft
141	Guide screw
145	Lock nut
146	Lock nut
147	Lock nut
148	Seal
149	Cap nut
150	Spring seat
155	Connecting link
156	Screw
157	Spring lock washer
158	Nut
159	Plate
160	Variable-fulcrum lever, sub-assembly
160/1	Variable-fulcrum lever
160/2	Lock washer
160/3	Support lever
160/4	Lock washer
160/5	Return spring
160/6	Control-lever shaft
167	Radial seal ring
168	Shim
170	Control lever
171	Spring lock washer
172	Nut
173	Full-load adjusting screw
174	Idle-speed adjusting screw
175	Max.-speed adjusting screw
176	Lock nut
177	Lock nut
236	Seal
237	Seal
250	Holder
251	Spring
252	Screw
257	Pipe
300	Torque-control edge cam
301	Lock washer
303	Lock washer
310	Seal
311	Screw plug
400	Holder
401	Holder

TYPE RLD-A, -B AND -C GOVERNORS

There are three different versions of the RLD governor.
The characteristic features of each individual design are described in this Section.

RLD-A version

1. This version is attached to the fuel-injection pump, type PE(S)-A and is mainly used in small and medium-sized vehicles.

2. This version cannot be used with the type PE(S)-AD...S fuel-injection pump, since fuel-injection pumps of this type produce considerable vibration during operation and this would result in premature wear of the governor components.

3. This version can likewise not be used in special-purpose vehicles (e.g. fire-brigade vehicles, cranes), since the full-load speed regulation of such vehicles in the medium and upper speed range is too great.

RLD-B version

1. This governor is an improved version of the RLD-A governor and is characterized by greater wear resistance on the part of the governor components.

2. The governor can be employed with the type PE(S)-AD fuel-injection pump.

RLD-C version

1. This governor features a smaller full-load speed regulation in the medium and upper speed range than the RLD-A and RLD-B versions.

2. The governor can be used in special-purpose vehicles and in normal vehicles.

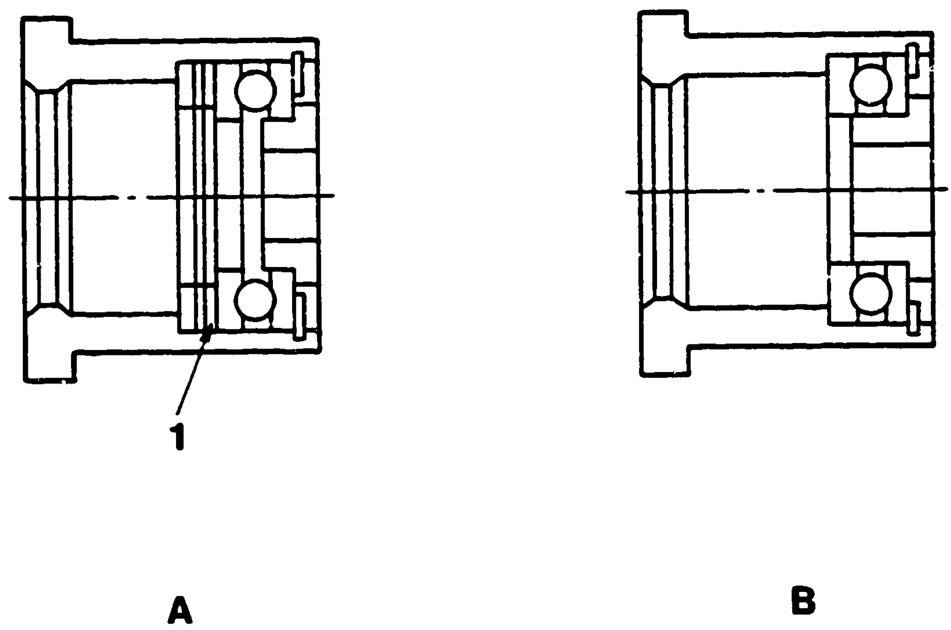


Fig. 129

A = Version RLD-B
B = Version RLD-A

1 = Rubber damper

DIFFERENCES BETWEEN GOVERNOR VERSIONS RLD-A AND RLD-B

Modification details

The pump effect of the fuel-injection pump produces vibrations which are transmitted to the different components and result in wear. A rubber damper was thus installed in the sliding sleeve to absorb the vibrations produced by the pump.

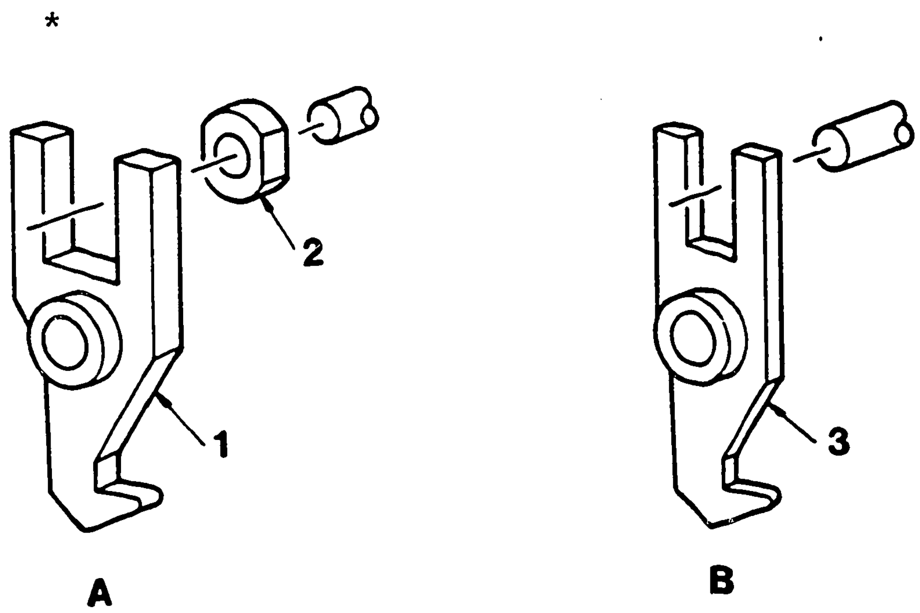


Fig. 130

A = Version RLD-B
B = Version RLD-A

1 = Sensing lever
2 = Link
3 = Sensing lever

* Link added in fork part of sensing lever

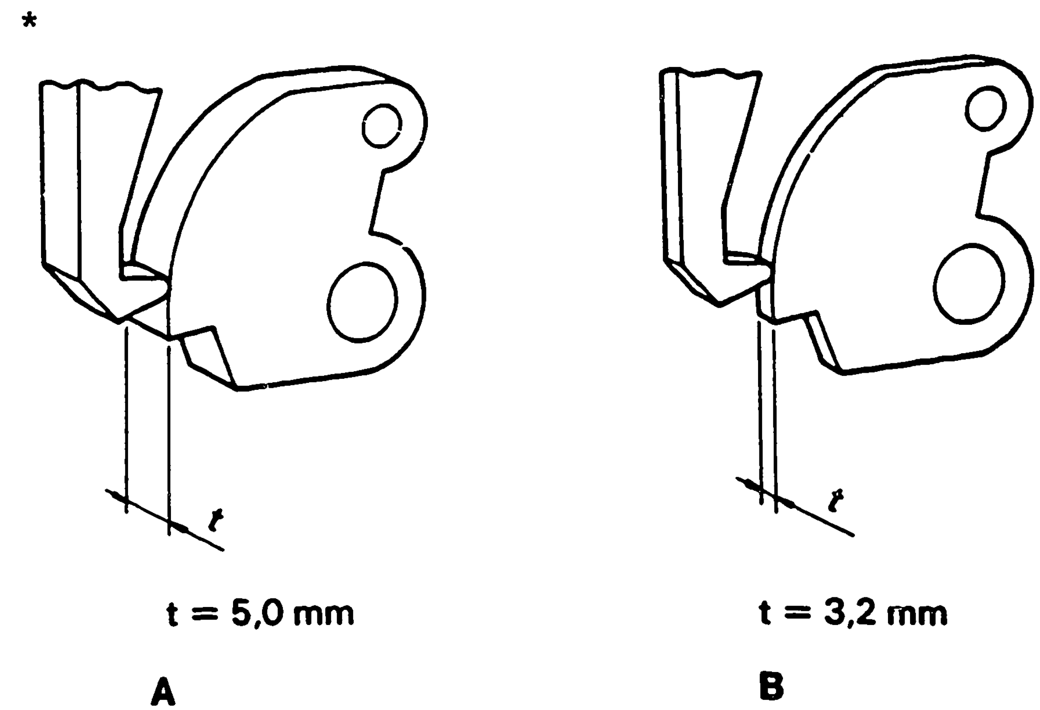


Fig. 131

* Increased sliding-surface width of torque-control edge cam and sensing lever

Differences between governor versions RLD-A and RLD-B

Modification details

As a consequence of the wear to which various components of the governor were exposed, components worked loose and shifted the control rod in the direction of increased delivery. The sliding-surface pressure of the various governor components was reduced with a view to improving wear resistance.

*

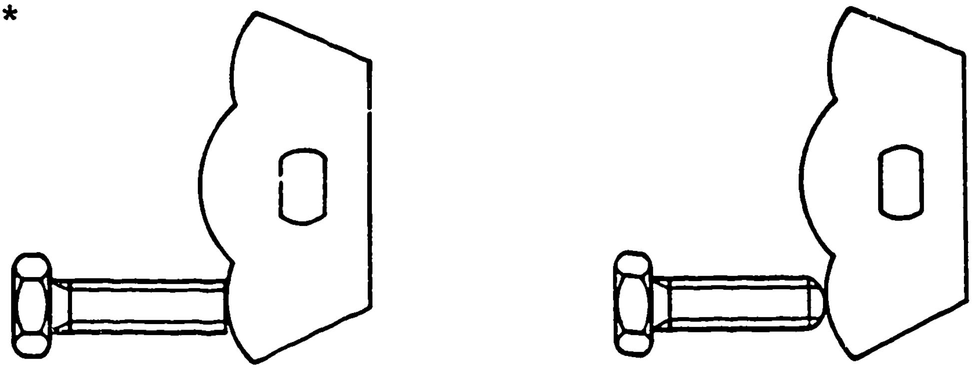
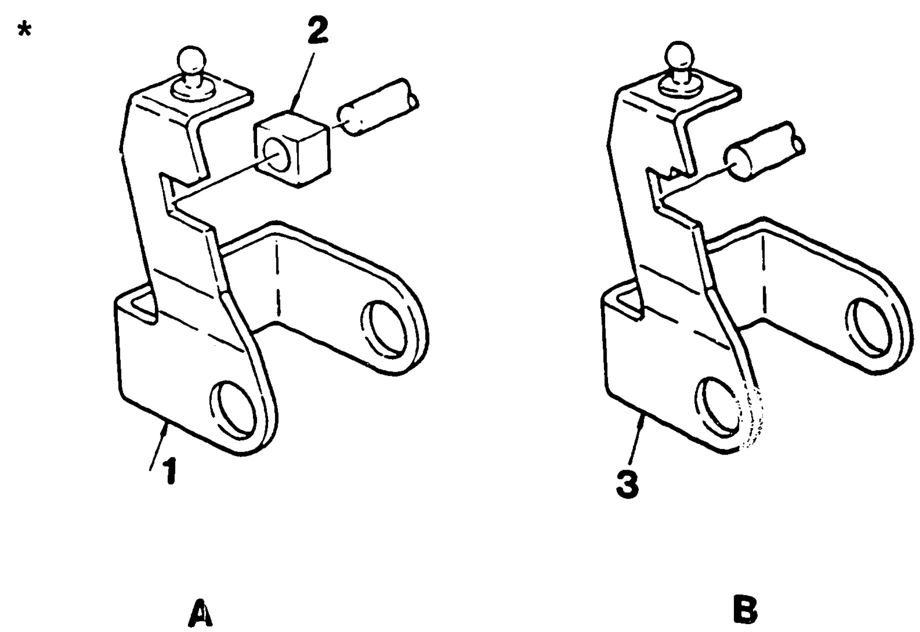


Fig. 132

A = Version RLD-B
B = Version RLD-A

Differences between governor versions RLD-A and RLD-B

* End of full-load adjusting screw flattened off



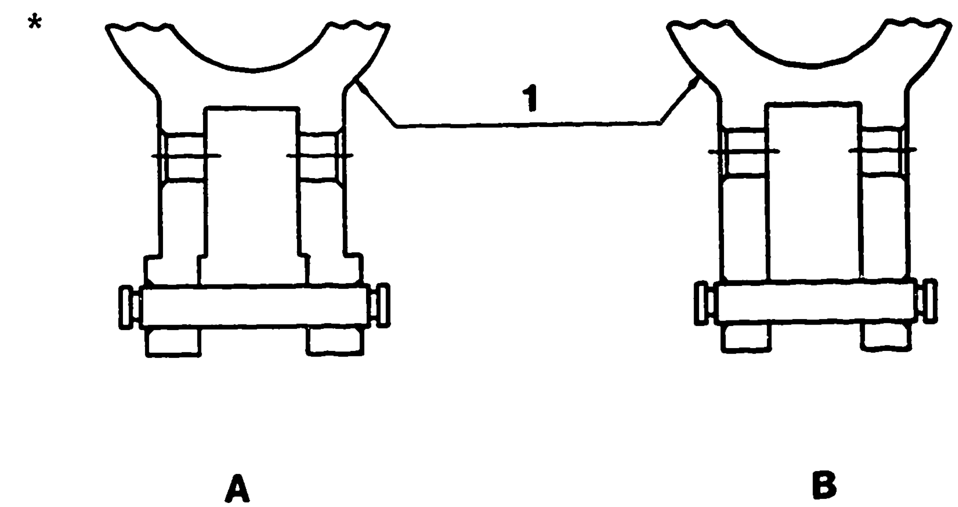


Fig. 133

A = Version RLD-B
B = Version RLD-A

1 = Guide lever
2 = Link
3 = Guide lever

* Link added in cut-out part of guide lever

Fig. 134

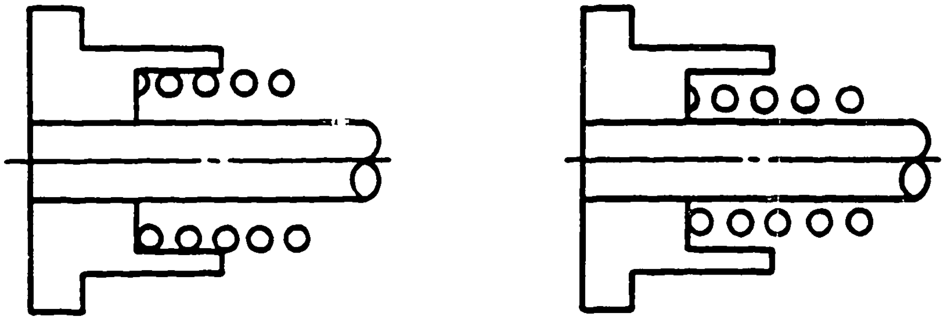
1 = Tensioning lever

* Increased bearing surface on bearing pin of sliding bolt in tensioning lever

Differences between governor versions RLD-A and RLD-B

Modification details

The wear to which various components of the governor were exposed resulted in certain components working loose, with the result that the control rod was shifted in the direction of increased delivery and the engine speed was reduced. The sliding-surface pressure of the various governor components was reduced with the aid of improving wear resistance.



A B

Fig. 135

A = Version RLD-B
B = Version RLD-A

Differences between governor versions RLD-A and RLD-B

Modification details

Inside diameter of inner governor spring increased, so as to avoid friction on governor shaft.

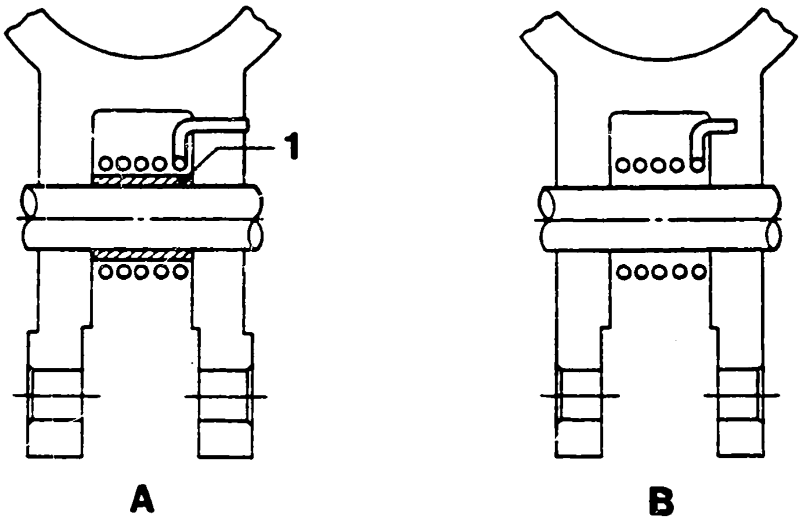


Fig. 136

A = Version RLD-B
B = Version RLD-A

1 = Bushing

Differences between governor versions RLD-A and RLD-B

* Flyweight bearing-pin diameter altered
  RLD-B = dia. 9 RLD-A = dia. 7

Modification details
The tensioning-lever shaft was provided with a bushing, so as to avoid friction with the return spring. The length of the return spring was increased, with a view to guaranteeing reliable connection.

Improvement in wear resistance of flyweights.

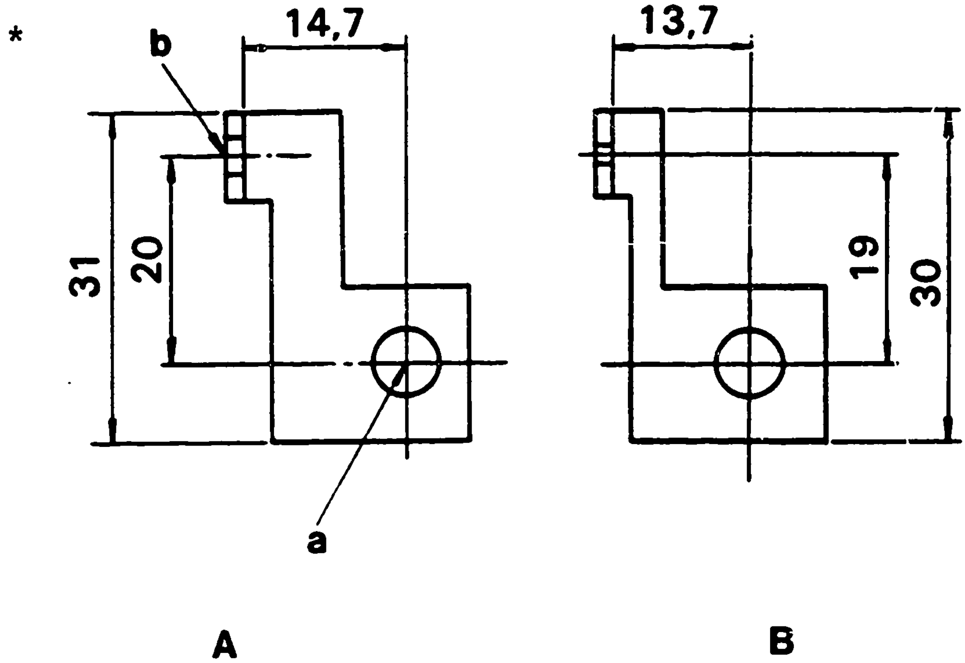


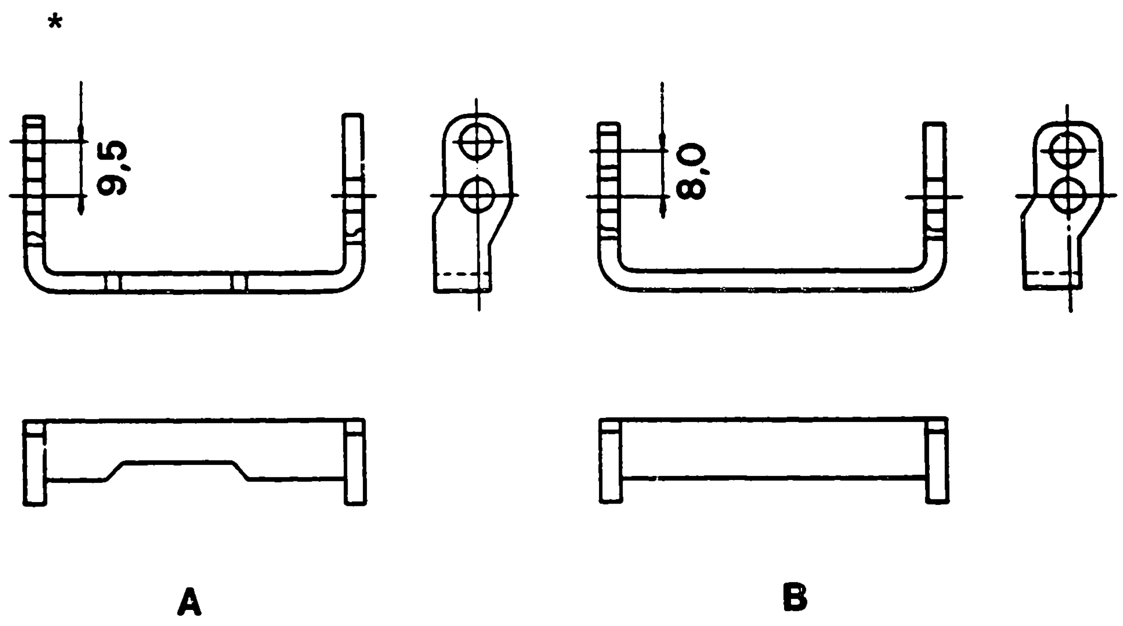
Fig. 137

* Alteration to position of hole for positioning starting spring

A = Version RLD-C
B = Version RLD-A (B)
a = Fastening-screw hole
b = Positioning hole for starting spring

DIFFERENCES BETWEEN GOVERNOR VERSIONS RLD-A (OR B) and RLD-C

The flyweight dimensions were increased on version C, so as to improve the full-load speed regulation in the medium and upper speed range. For this reason, it was also necessary to increase the size of the governor cover and the governor housing.
Modification details
In conjunction with the modification to the flyweight shape, collision in the governor housing is avoided.



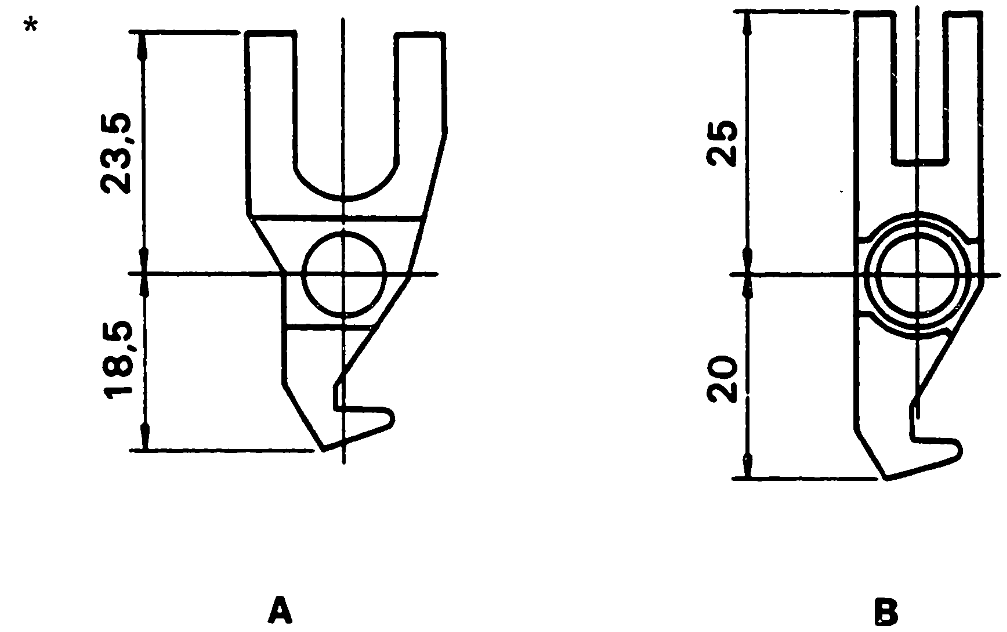


Fig. 138

A = Version RLD-C
B = Version RLD-A (B)

* Change in shape of U-lever

Fig. 139

* Modification to pivot and shape of sensing lever

Differences between governor versions RLD-A (or B) and RLD-C

Modification details

Collision in the governor housing is avoided in conjunction with the alteration to the flyweight shape.

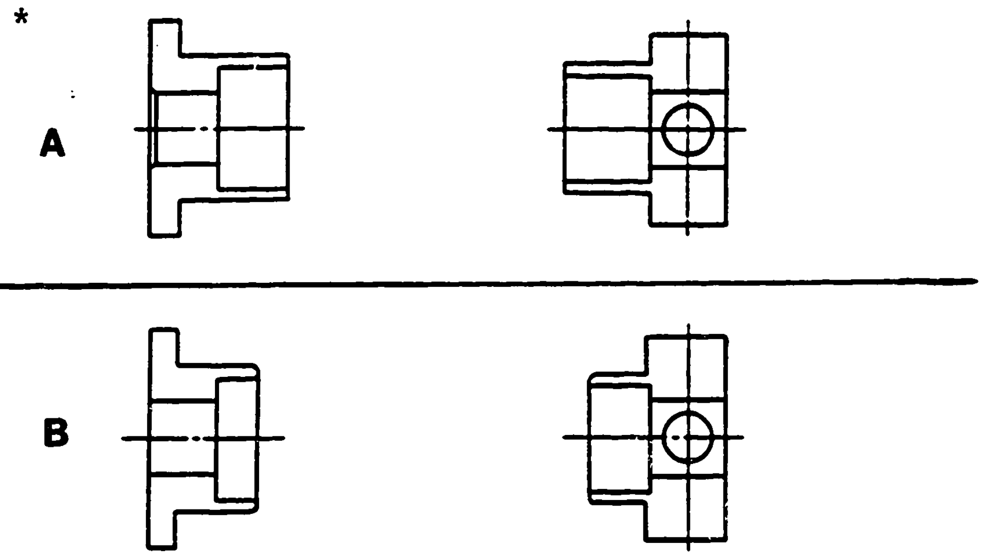


Fig. 140 * Shape of spring seat altered

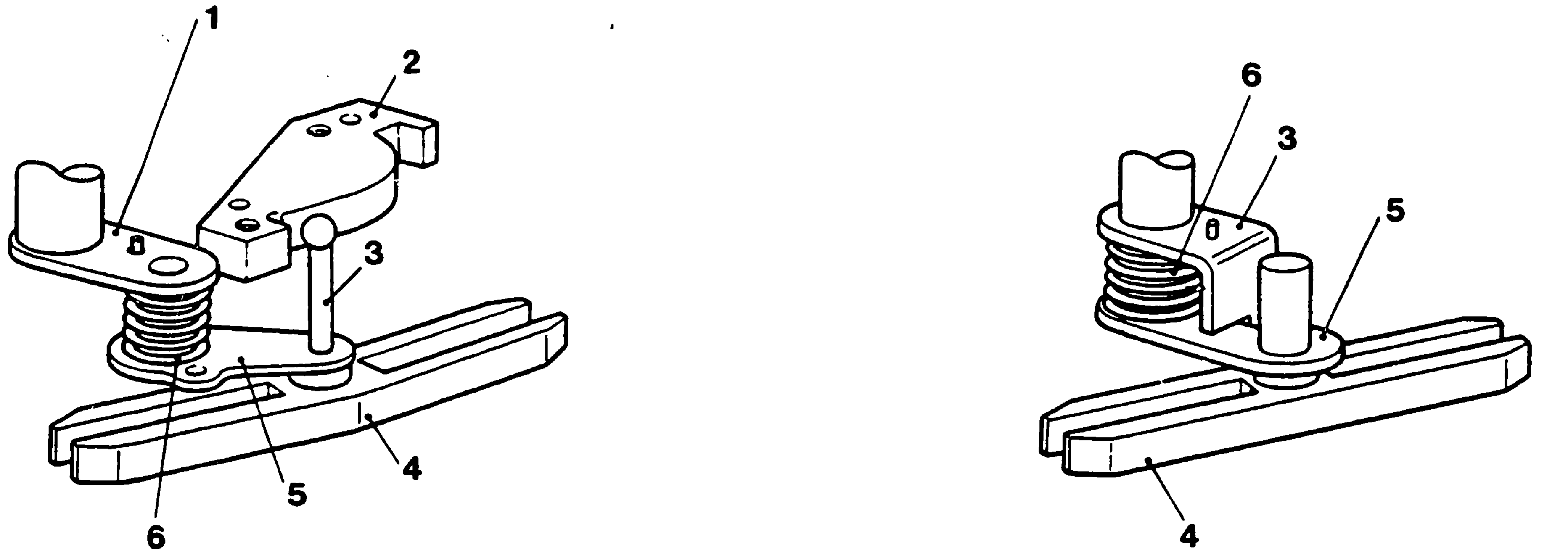
A = Version RLD-C
B = Version RLD-A (B)

Differences between governor versions RLD-A (or B) and RLD-C

Modification details

Guide in spring seat lengthened, so as to guarantee good connection.

*



A

B

Fig. 141

1 = Support lever no. 1
2 = Edge cam
3 = Pin
4 = Variable-fulcrum lever
5 = Support lever no. 2
6 = Return spring (2)

A = Version RLD-C
B = Version RLD-A (B)

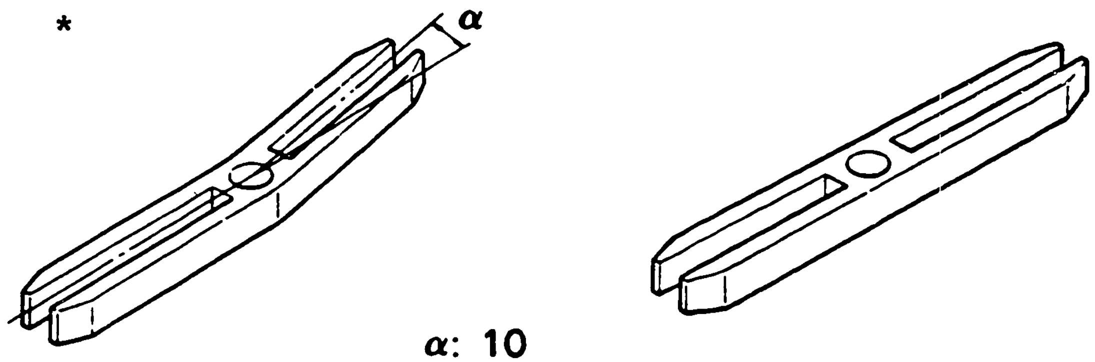
3 = Bell crank
4 = Variable-fulcrum lever
5 = Support lever
6 = Return spring (2)

Differences between governor versions RLD-A (or B) and RLD-C

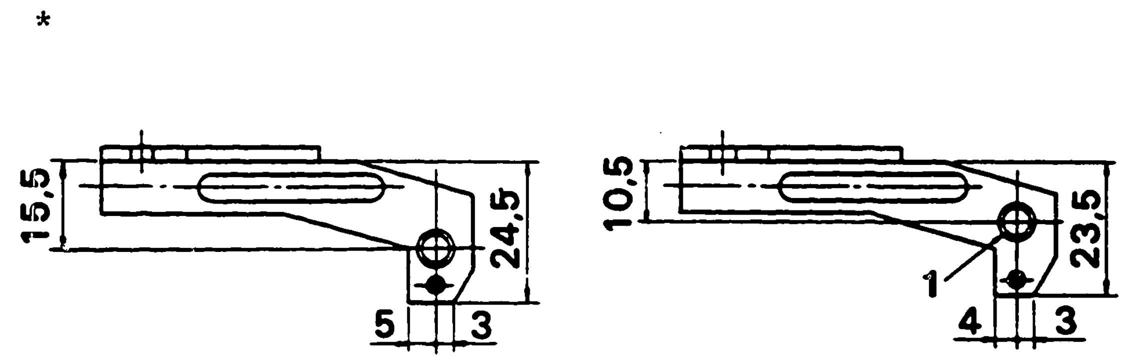
Flyweight stroke changed from 13 to 15 mm

* Edge cam added on inside top of governor cover and shape of support lever changed.

Modification details
Improved full-load speed regulation in medium and upper speed range.



A B



A B

Fig. 142

A = Version RLD-C
B = Version RLD-A (B)

Differences between governor versions RLD-A (or B) and RLD-C

* Modified shape of variable-fulcrum lever

Design modifications

Improved full-load speed regulation in medium and upper speed range.

Fig. 143

1 = Spherical pin

* Modified position of spherical pin on connecting link

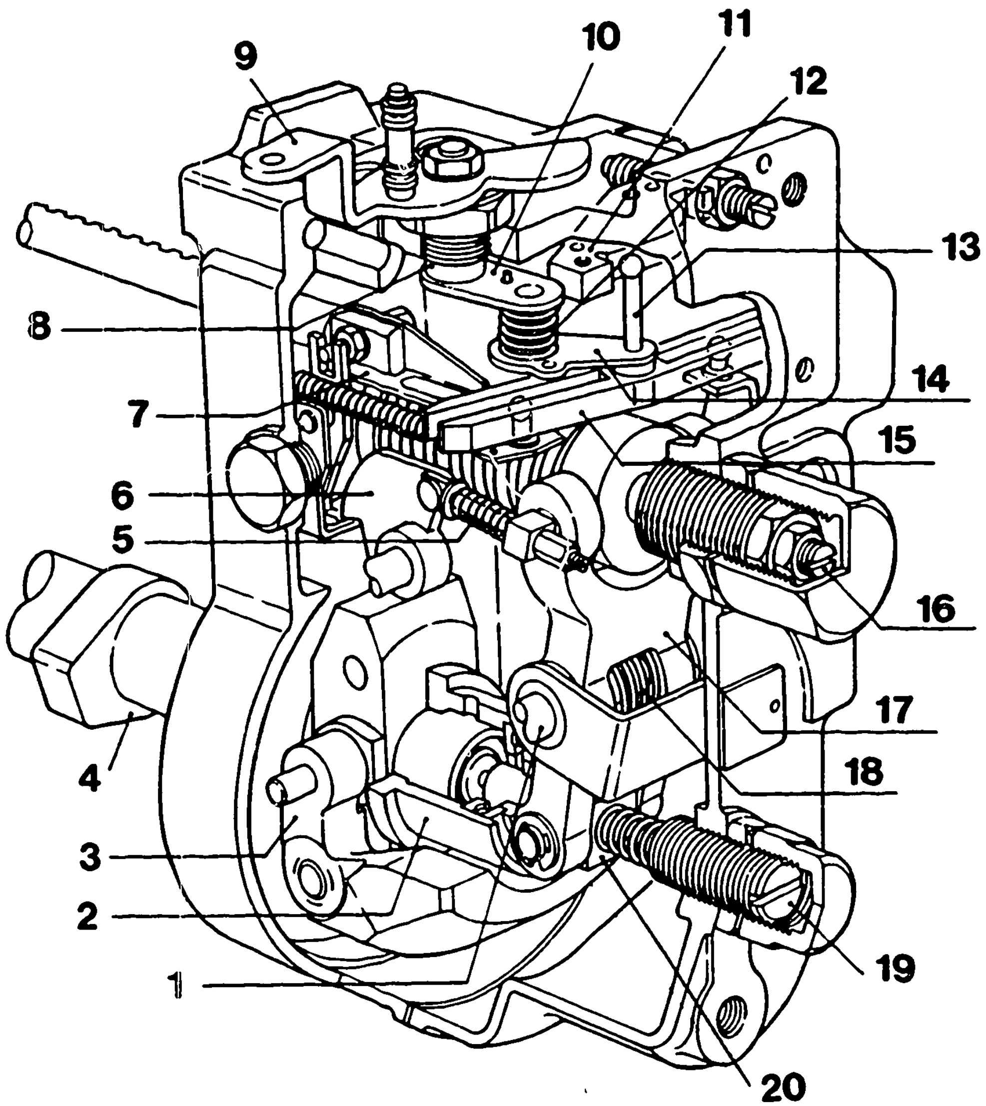


Fig. 144

Governor version RLD-C

1 = Tensioning-lever shaft
2 = Sleeve
3 = Flyweight
4 = Camshaft
5 = Connecting rod and spring
6 = Torque-control edge cam
7 = Connecting link

8 = Control-lever shaft
9 = Control lever
10 = Support lever no. 1
11 = Edge cam
12 = Return spring (2)
13 = Pin
14 = Support lever no. 2

15 = Variable-fulcrum lever
16 = Governor shaft
17 = Tensioning lever
18 = Return spring (1)
19 = Idle-speed adjusting screw
20 = Sliding bolt

Fig. 144 illustrates design of mechanical governor version RLD-C.

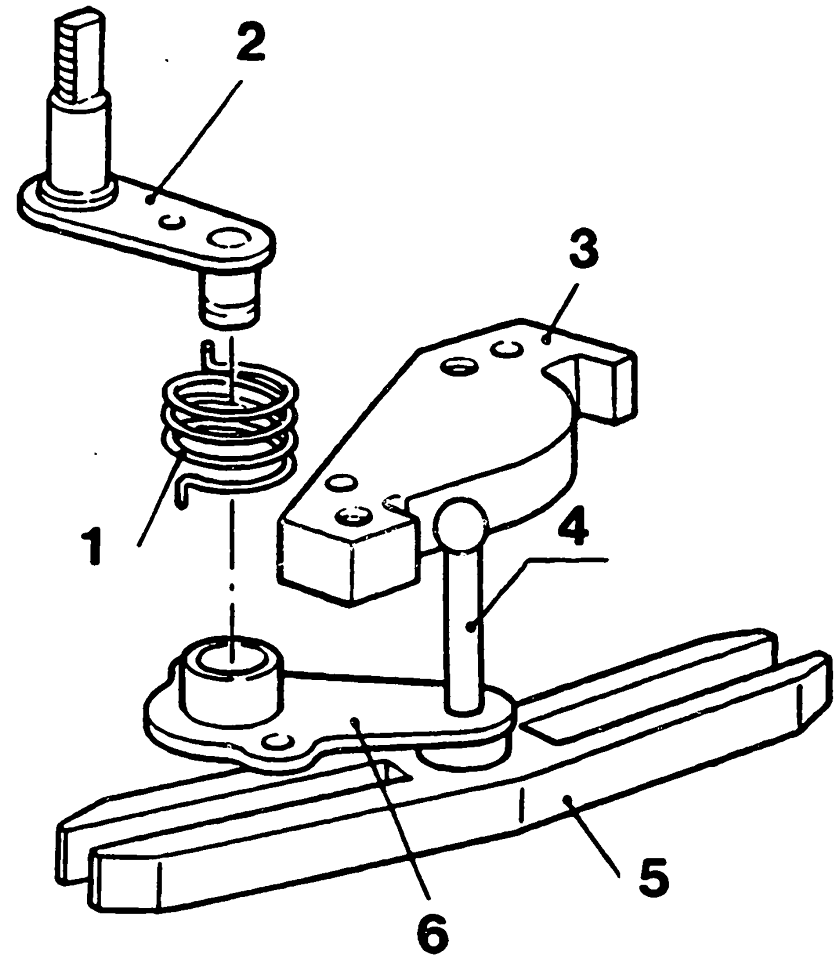


Fig. 145

1 = Return spring (2)
2 = Support lever no. 1

3 = Edge cam
4 = Pin

5 = Variable-fulcrum lever
6 = Support lever no. 2

Governor version RLD-C (Description)

Basically, the mechanical governor version RLD-C has the same design as the RLD-A governor. In order to improve the full-load speed regulation in the medium and upper speed range, an edge cam was added at the top of the governor cover on the inside and the support-lever mechanism was altered to a twin-lever design. The support lever no. 1 is pressed in into this control-lever shaft. Support lever no. 2 (which supports the variable-fulcrum lever) is held by the return spring (2). Support lever no. 2 features a pressed-in pin which permits movement along the curved surface of the edge cam. (Support lever no. 2 is supported such that it is turned by the return spring (2) in a counter-clockwise direction). Support levers nos. 1 and 2 are thus both moved when the control lever is operated and the pin of the variable-fulcrum lever shifted.

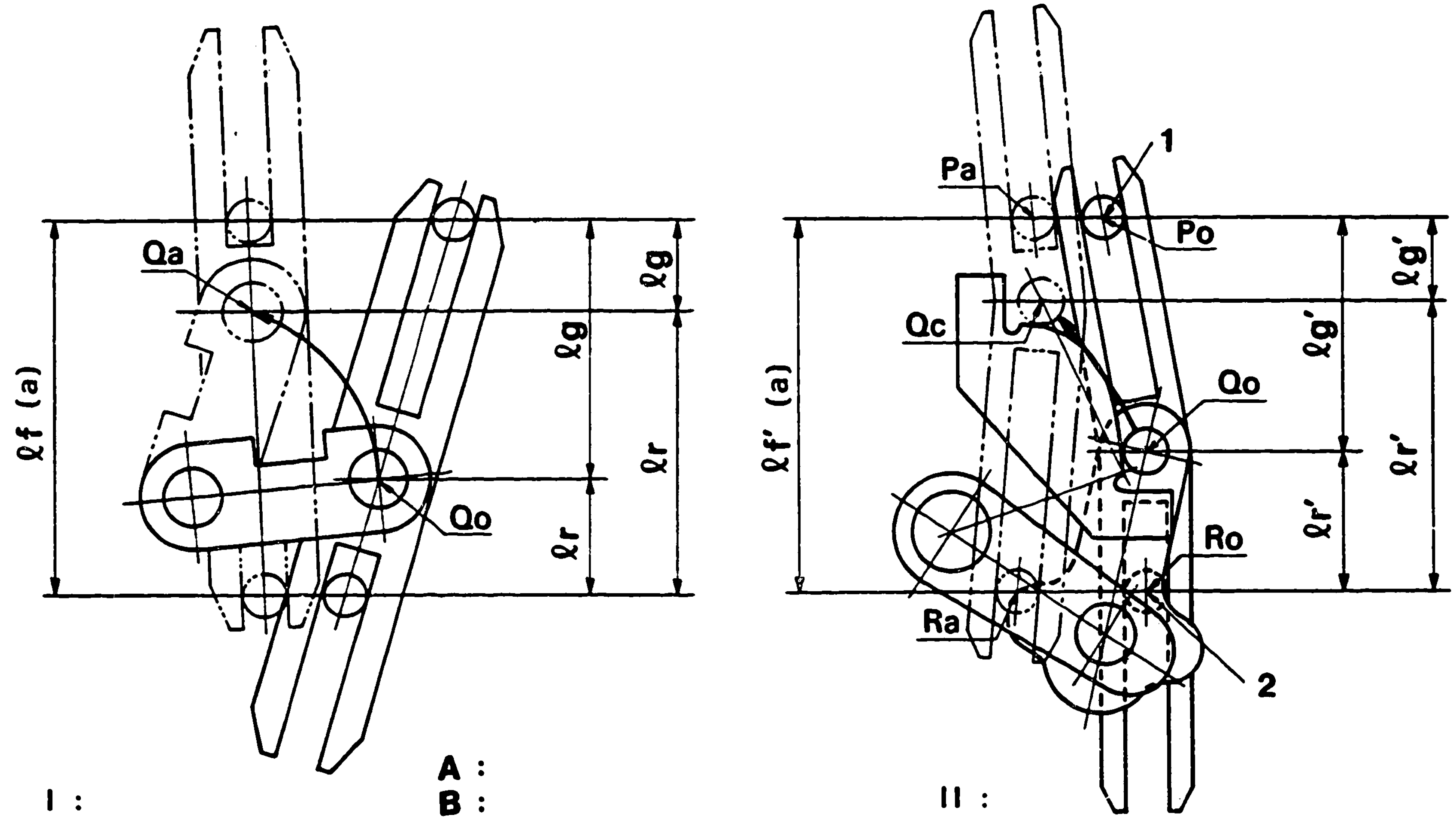


Fig. 146

I : Version RLD-A

A: Solid line: at low speed
B: Dashed line: at high speed

(a) fixed

1 = Spherical pin of guide lever
2 = Spherical pin of connecting link

II : Version RLD-C

Comparison of governors RLD-A and RLD-C

The pivot of the variable-fulcrum lever in the RLD-A governor moves in a circle, the radius of which is equal to the distance between the two pivots of the support lever as illustrated Fig. 146 - I.

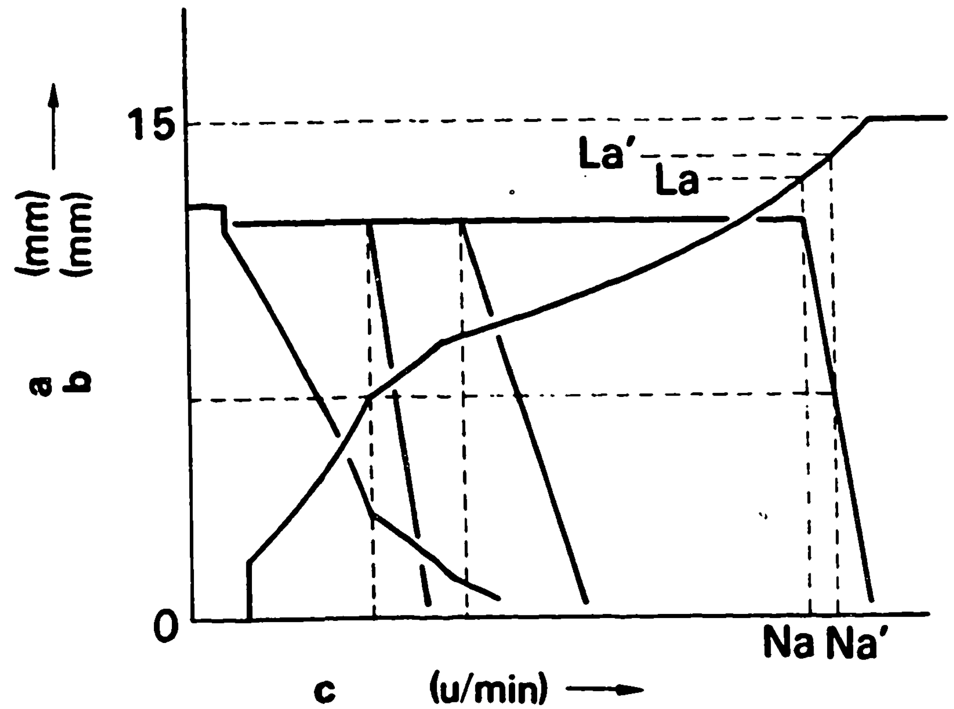
The lever ratio of the variable-fulcrum lever changes between 1 and 4 as a function of the lever position. With the RLD-C governor, the pin of support lever no. 2 is engaged when it moves along the edge cam. The lever ratio of the variable fulcrum lever therefore changes as a function of the lever position from 1.3 to 7.

Comparison of RLD-A and RLD-C governors

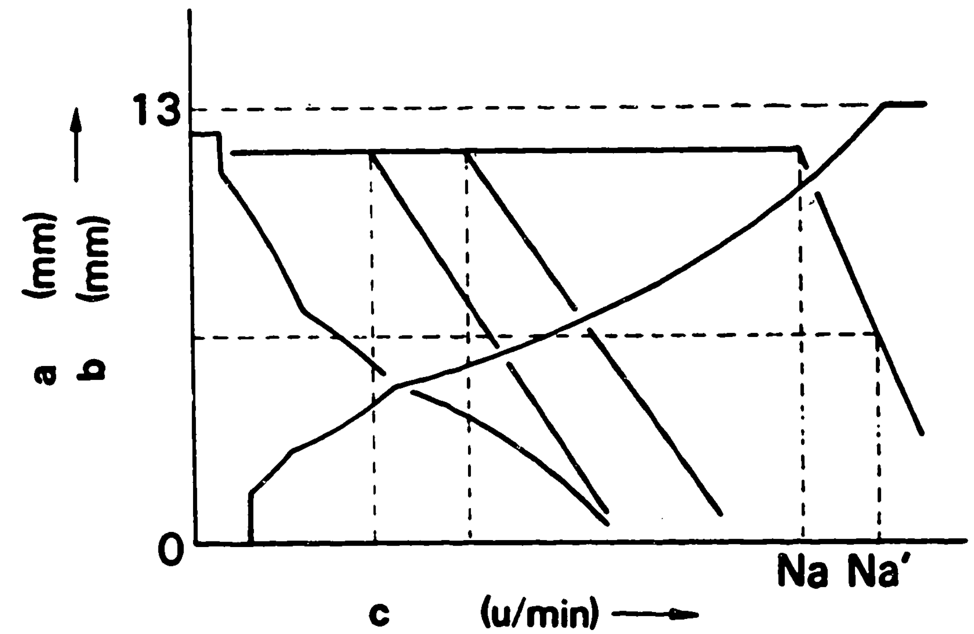
(continued)

Furthermore, a governor of this type has a larger flywheel stroke than the RLD-A version and features an improved speed control characteristic (speed control behaviour).

Version	Lever ratio	Total flyweight stroke
RLD-A	1.0 - 4	13 mm
RLD-C	1.3 - 7	15 mm



I:



II:

I: Version RLD-C

a = Control-rod travel
b = Flyweight stroke
c = Pump speed

Fig. 147

II: Version RLD-A

a = Control-rod travel
b = Flyweight stroke
c = Pump speed

Fig. 147 illustrates the relationship between control-rod travel and flyweight stroke as a function of pump speed.

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